CORES – Complex Organizational Reasoning System
CASOS Technical Report
Michael Kowalchuck, Siddhartha Singh and Kathleen M. Carley
September 2004
CMU-ISRI-04-131

Carnegie Mellon University
School of Computer Science
ISRI-Institute for Software Research International
CASOS – Center for Computational Analysis of Social and Organizational Systems

Abstract

In Operations Other Than War (OOTW), there is a need for intelligence analysts and military planners to anticipate the actions and responses of complex networked organizations such as terrorist groups, nation-states and key actors (such a high-level leaders). The Complex Organizational Reasoning System (CORES) is a multi-agent network simulation model that uses organizational, social, political and economic dynamics to generate predictions of the likely actions and responses of these actors when involved in an adversarial context.

1 This research was supported in part by the Defense Advanced Research Projects Agency (DARPA) under contract DAAH01-03-C-R169 and the National Science Foundation (NSF) grant IGERT9972762 to the Carnegie Mellon Center for Computational Analysis of Social and Organizational Systems (CASOS). Additional support was provided by the CASOS program in the Institute for Software International at Carnegie Mellon University. Any opinions, findings, conclusions or recommendations expressed in this report are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the Defense Advanced Research Projects Agency, the National Science Foundation, or the U.S. government.
We would like to thank Aptima and in particular Kari Chopra and Keith Baker for comments on earlier portions of this report.
# Report Documentation Page

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

<table>
<thead>
<tr>
<th>1. REPORT DATE</th>
<th>2. REPORT TYPE</th>
<th>3. DATES COVERED</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEP 2004</td>
<td></td>
<td>00-09-2004 to 00-09-2004</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. TITLE AND SUBTITLE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CORES - Complex Organizational Reasoning System</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5a. CONTRACT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5b. GRANT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5c. PROGRAM ELEMENT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5d. PROJECT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5e. TASK NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5f. WORK UNIT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. AUTHOR(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carnegie Mellon University, School of Computer Science, Pittsburgh, PA, 15213</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8. PERFORMING ORGANIZATION REPORT NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10. SPONSOR/MONITOR’S ACRONYM(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>11. SPONSOR/MONITOR’S REPORT NUMBER(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>12. DISTRIBUTION/AVAILABILITY STATEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved for public release; distribution unlimited</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>13. SUPPLEMENTARY NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>The original document contains color images.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>14. ABSTRACT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>15. SUBJECT TERMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>16. SECURITY CLASSIFICATION OF:</th>
<th>17. LIMITATION OF ABSTRACT</th>
<th>18. NUMBER OF PAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. REPORT unclassified</td>
<td>unclassified</td>
<td>63</td>
</tr>
<tr>
<td>b. ABSTRACT unclassified</td>
<td>unclassified</td>
<td></td>
</tr>
<tr>
<td>c. THIS PAGE unclassified</td>
<td>unclassified</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>19a. NAME OF RESPONSIBLE PERSON</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
Keywords: Organization, computer simulation, organizational model, decision making model, CORES
# Table of contents

1. Model Description...................................................................................................1  
   1.1 Actors...........................................................................................................1  
   1.2 Goals............................................................................................................1  
   1.3 Actions.........................................................................................................2  
   1.4 Resources.....................................................................................................2  
   1.5 Effects..........................................................................................................2  
   1.6 Relations......................................................................................................2  
   1.7 Workflow.....................................................................................................3  
2. Program Execution...................................................................................................7  
   2.1 Sample Configuration File...........................................................................7  
   2.2 General Format of Configuration File.........................................................9  
3. System Input..........................................................................................................10  
   3.1 Simulation Parameters Section..................................................................10  
   3.2 Input File Paths Section.............................................................................11  
       3.2.1 Cores Configuration File Variables....................................................11  
       3.2.2 Client Machine Configuration.............................................................12  
       3.2.3 MySQL Database Configuration.........................................................13  
   3.3 Input File Paths Section.............................................................................13  
4. System Output........................................................................................................17  
   4.1 Output Flags Section..................................................................................17  
   4.2 Output File Paths Section...........................................................................17  
5. System Requirements.............................................................................................28  
6. Performance Characteristics..................................................................................28  
7. Illustrative Samples................................................................................................28  
   7.1 Execute Sample Scenario...........................................................................28  
   7.2 Explanation of Results...............................................................................29  
8. Sample Input..........................................................................................................30
I. Index of Table
Table 1: Performance Characteristics .................................................................28
Table 2: Influence .................................................................................................30
Table 3: Hostility ...................................................................................................30
Table 4: Volatility ..................................................................................................30
Table 5: Tension Threshold ..................................................................................31
Table 6: Pause Injections .....................................................................................31
Table 7: Goal x Effect ............................................................................................31
Table 8: Actor Resource .......................................................................................36
Table 9: Actor x Goal .............................................................................................43
Table 10: Actor Tendencies ...................................................................................45
Table 11: Beliefs ....................................................................................................48
Table 12: Action x Effect ......................................................................................51
Table 13: Action Details ........................................................................................55
Table 14: Action x Resource Requirement ............................................................57
Table 15: Injected Actions .....................................................................................59

II. Index of Figures
Figure 1: CORES - Overall Model Workflow .......................................................4
Figure 2: CORES - Detailed Model Workflow ......................................................5
Figure 3: Client Side Database Configuration .......................................................13
Figure 4: Israeli Hostility Toward Hamas ..............................................................29
Figure 5: Israeli Belief in Israeli Actions ..............................................................30
CASOS Technical Report

The anticipated benefits of CORES are that it will enable the user to anticipate key hostile activities, thus neutralizing the enemy’s ability to surprise. Additionally, it will enable the user to reason through potential courses of action using "What-if" analysis capabilities to estimate alternative and likely responses. Finally, it will enable the user to test the efficacy of plans for influencing others. CORES advances the state of the art in political actor research by integrating models of social influence, organizational structure, social networks, and resource dependency in a strategic decision context. Potential areas of application include military intelligence and learning, political and corporate negotiation, disaster relief and crisis management, and business intelligence.

1. Model Description

CORES is a multi-agent network model of strategic decision making that generates predictions based on conflict scenarios. The scenarios are represented within a framework consisting of Actors, Resources, Goals, Actions, Effects and Relations. Based on these entities, the model generates predictions of likely actions and responses of actors.

1.1 Actors

Actors are the players or participants in the conflict. The attributes associated with an actor are:

- **Volatility:** constrained between 0 and 1. Indicates how an actor responds to changes in hostility. An actor with a volatility of 0 will never change hostility; an actor with a volatility of 1 will change hostility by the full magnitude of hostility changes.

- **Tension Threshold:** Constrained between 0 and 1, based generally on the hostility scale. Indicates at which negative hostility value or greater an actor will retaliate against another actor. The magnitude (absolute value) of negative hostility values is compared to the tension threshold to determine which actors may be retaliated against. For example, an actor with a hostility of -.9 towards another actor and a tension threshold of .8 will retaliate against that actor; but if it had a hostility of -.7 would not.

1.2 Goals

Goals are things actors aim toward. Examples include curbing terrorism, increasing Arab power, gaining Palestinian sovereignty/independence, etc. These are coded by the scenario developer based on stated or reasoned goals of various actors.
1.3 Actions

Actions are things that actors can do. Examples include Israel Invades Palestinian Territory, Suicide Bomb, Provide Humanitarian Relief, Call for peace Talks, etc. These are coded by the scenario developer into a scenario specific response field; actions available will differ widely depending on nature of scenario and nature of actors. Actions have the following attributes:

- Duration: determines how long after the decision is made to take the action until the effects take place.
- Category: currently must be one of the following: Military, Diplomatic, Financial Economic, or Humanitarian.
- Sender: the actor who initiates this action
- Receiver 1: primary receiver of the action.
- Receiver 2,3,4,etc: possible secondary receivers of the action

1.4 Resources

Resources are things that Actors have. Examples include Israeli Money, Land in Gaza Strip, Land in West Bank, American Casualties, etc. Resources have the following attributes:

- Growth Rate: is the amount by which the resource increases/decreases every time period.

1.5 Effects

Effects are the results of actions. An example of action/effect pair is Israel Invades Palestinian Territory causes Israeli money to decrease by the amount used up in the invasion.

1.6 Relations

The model framework includes the following entity relationships:

- Actor by Actor relations

  There are two types of Actor by Actor relations:

  - Hostility: Indicates degree of enmity between actors.
  - Influence: Indicates amount of effect an actor has on other actors.

- Actor by Goal relation

  This is the amount an actor believes in/values/wants to achieve a specific goal.

- Actor by Action relations
There are two types of Actor by Action relations:

- Tendency: Indicates the initial likelihood of an actor taking a particular action.
- Belief: Indicates the initial belief that an actor has in an action.

- Resource by Actor relation

  This is the amount of a particular resource that an actor possesses initially.

- Goal by Resource relation

  This indicates how much changes in resources correlate with specific goals. Since changes in resources are essentially effects, this relation can also be viewed as a Goal by Effect relation.

- Action by Resource Requirement relation

  This is the amount of a particular resource that is required to carry out a particular action.

- Action by Effect relation

  This is the effect of a particular action. Since effects are essentially resource changes, this can be viewed as the effect on resources of a particular action. Note: sometimes an action will require certain resources but will not deplete those resources when carried out. This can be achieved by putting the resource requirement in the Action by Resource Requirement relation and leaving it out of the Action by Effect relation.

1.7 Workflow

The CORES model, as written, is suited for modeling in a computer simulation as it describes complex, multi-agent, non-linear, dynamic behavior.

In order to develop a simulation from the model, two primary modules have been implemented - a module to describe the decision that actors actually take, and a module to update the scenario state based upon the effects of the decisions made.
Steps 1 and 2 from Figure 1 describe the decision taking process and Step 3 describes the update process.

Below is the detailed flow diagram of the CORES simulation:
Figure 2: CORES - Detailed Model Workflow
The following steps constitute the execution of a typical run in a scenario:

1) An actor computes how beneficial actions are to him in terms of getting him closer to his goals.

2) Then, using the Noah Friedkin Belief Model, the actor computes his belief in the various actions.

3) Based on values from steps 1 and 2, the actor computes probabilities of taking various actions.

4) Next is a decision point, where if the actor’s (sender) hostility towards any other actor (receiver) is greater than his (sender’s) tension threshold, he (sender) reacts and takes a hostile (reactive) action towards the receiver. This is contingent upon the sender having enough resources to take the reactive action. Also the hostility of Sender towards receiver is adjusted.

5) If the all the hostilities are below the tension threshold, the actor prepares to take a proactive action. In this case, assuming bounded rationality, the actor evaluates a subset of the available actions and executes the most beneficial one.

6) After either step 4 or 5, Sender and Receiver resources are updated, the influence of Sender on Receiver is updated and the hostility of Receiver towards Sender is updated.

7) This is done for each actor in the scenario.

8) This is repeated for all time periods.

Notes:

1) Every time period the actor will decide whether or not to take an action. The actor will not take an action if the actor does not have enough resources to take an action. The actor will not take an action of the probability of taking an action is too low. An action “take no action” could be coded into the scenario, but it must be coded as such to make it favorable to the actor to take it.

2) The actor can start at most one action every time period, but since actions have duration certain actions will not end in the same time period that they are started. Actions can span multiple time periods. This means that an actor can start an action in one time period and it will not end until several time periods later. In the mean time the actor could have started several other actions. The number of actions an actor can have running at the same time is only limited by the actor’s resources.
3) When an action is started its effect on the sender (the actor who starts the action) is felt in the time period that the action is started. However the effect of the action on the receivers is not felt until the time period that the action ends.

2. Program Execution

The CORES system runs as an executable called cores.exe. There is only one command line parameter to this executable which is the full path of a configuration file. Thus a sample command to run cores would be:

e.g. C:\TestDir>cores.exe ConfigurationFile.txt

assuming both cores.exe and ConfigurationFile.txt are in the TestDir folder.

Currently CORES uses csv files for input. The input filenames, output filenames, what output to create, and how to format the output is configured through the configuration file.

2.1 Sample Configuration File

Here is a sample configuration file:

#one line per statement
# lines starting with # are comments
#

[SIMULATION PARAMETERS]
input type = FILES
#input type = DATABASE
dbName = coresDB
dbUID = userX
dbPWD = 1122345
dbServerName = windtalker.wv.cs.cmu.edu
number of runs = 1
number of time periods = 26
# Make sure you put the final directory delimiter
# on the input and output directories!
input directory = C:\Documents and Settings\kf3cr\My Documents\normalIntifada\output directory = C:\Documents and Settings\kf3cr\Documents\normalIntifadaOutput\n
[INPUT TABLE NAMES]
action x effect = actionBYeffect
action x resource requirement = actionBYresourceReq
action details = actionDetails
actor x goal = actorBYgoal
actor x resource = actorBYresource
beliefs = beliefs
goal x effect = goalBYeffect
hostility = hostility
influence = influence
injected actions = injectedActions
tendencies = tendencies
tension threshold = tensionThreshold
volatility = volatility

[INPUT FILE PATHS]
action x effect = actionBYeffect.csv
action x resource requirement = actionBYresourceReq.csv
action details = actionDetails.csv
actor x goal = actorBYgoal.csv
actor x resource = actorBYresource.csv
beliefs = beliefs.csv
goal x effect = goalBYeffect.csv
hostility = hostility.csv
influence = influence.csv
injected actions = injectedActions.csv
tendencies = tendencies.csv
tension threshold = tensionThreshold.csv
volatility = volatility.csv

pause injections = pauseInjectionsFile.csv
#pause injections =

[OUTPUT FILE PATHS]
timeSummaryFile=timeSummaryOutput.txt
#actResourceFile=
hostilityMatFile=hostilityMatOutput.txt
influenceMatFile=influenceMatOutput.txt
beliefsMatFile=beliefsOutput.txt
actionTendFile=actionTendOutput.txt
probActionMatFile=probActionMatOutput.txt
actBenefitMatFile=actBenefitMatOutput.txt

actorResourceFile =Israel;IsraelResources.txt
actorResourceFile = Hamas;HamasResources.txt

actorDeltaResourceFile =Israel;IsraelDeltaResources.txt
[OUTPUT FLAGS]
print names = true
print format = CSV
# print format = NORMAL

timeSummary=true
# actResource=false
hostilityMat=true
influenceMat=true
beliefsMat=true
actionTend=true
probActionMat=true
actBenefitMat=true

actorResourceFlag=Israel;true
actorResourceFlag=Hamas;true
actorDeltaResourceFlag=Israel;true

2.2 General Format of Configuration File

Here is a description of the general format of the configuration file:

Any line that starts with '#' is a comment and is ignored. Empty lines are allowed.

Each line is a variable and its assigned value, example: actBenefitMat=true. Here we see
the actBenefitMat variable being assigned to true.

Not all variables are necessary for a simulation run, but some are. The variables that are
absolutely necessary are those in the input file paths section. These variables must be in
the configuration file along with values for each. The mandatory variables are:

action x effect = actionBYeffect.csv
action x resource requirement = actionBYresourceReq.csv
action details = actionDetails.csv
actor x goal = actorBYgoal.csv
actor x resource = actorBYresource.csv
beliefs = beliefs.csv
goal x effect = goalBYeffect.csv
hostility = hostility.csv
influence = influence.csv
injected actions = injectedActions.csv
tendencies = tendencies.csv
tension threshold = tensionThreshold.csv
volatility = volatility.csv
The values on the right of these mandatory values are CSV files. They will be discussed in detail later. All of the sections of the configuration file will now be explained.

3. System Input

The configuration file contains four sections namely: Simulation Parameters, Input File Paths, Output File Paths, and Output Flags. The first two are input related and the latter two configure the output. Here is a detailed description of the input related sections of the Configuration File:

3.1 Simulation Parameters Section

The simulation parameters section contains three variables:

- number of runs = 1
- number of time periods = 26
- input directory = C:\path\to\IO\files
- output directory = C:\path\to\IO\files

- number of runs

This is the number of runs over which the results will be averaged. It is assumed to be one if it is not set in the configuration file. If it is set in the configuration file, the simulation will use that.

- number of time periods

This is the number of time periods in a run. It is assumed to be 5 if it is not found in the configuration file.

- input directory

This is the path that is prepended to all input filenames (in the input file paths section, discussed next) specified in the configuration file. The “input directory” variable essentially tells CORES where to look for the input files. The path to the files could also be specified when each file is specified, but if the location of the file changes, then each line in the configuration file must be changed. With the “input directory” variable only one line has to be changed if the file locations change.

- output directory

This is the path that is prepended to all output filenames (in the output file paths section, discussed under System Output) specified in the configuration file. The “output directory” variable essentially tells CORES where to look for the input files. The path to the files could also be specified when each file is specified, but if the location of the file
changes, then each line in the configuration file must be changed. With the “output
directory” variable only one line has to be changed if the file locations change.

3.2 System Input from a MySQL Database
Cores can use a MySQL database as its input source as an alternative to the csv input
files. Cores must have several important variables set in its configuration file before it
can use a database. The MySQL database and the client machine (the one running cores)
must be configured properly as well.

3.2.1 Cores Configuration File Variables

The following variables must be set in the SIMULATION PARAMETERS section:

```plaintext
#input type = FILES
input type = DATABASE
dbName = coresDB
dbUID = userX
dbPWD = 12345678
dbServerName = someMachine.someDomain.com
```

Note that there are two “input type” lines, but one of them is commented out. The
commented line shows how to configure cores to use files as its input. The default input
type is files, but it is always good to explicitly set the desired type. If the input type is set
to DATABASE all the parameters in the INPUT TABLE NAMES section will be
considered and those in the INPUT FILE PATHS section will be ignored. If the input
type is set to FILE it is vice versa.

- `dbName`

This is the name of the database within the MySQL database management system that
has the input. This should be available from the MySQL administrator.

- `dbUID`, `dbPWD` and `dbServerName`

These are the username, password, and server name for the MySQL server. Again, all of
these should be available from the MySQL administrator. Note that the password is not
stored in any type of encrypted format. This means that anybody who can read the
configuration file for cores can logon and query the database. Make sure that the admin
does not give this user privileges to edit the database.

Note: The `dbName` variable corresponds to the “Database Name” field in the MyODBC
driver configuration window (see below). `dbUID` corresponds to the “User” field, and
dbServerName corresponds to the “Host/Server Name” field. In a future release of
CORES a dbPort variable will probably be available as well that would correspond to the
“Port” field in the MyODBC configuration window.
The INPUT TABLE NAMES section must look something like this:

action x effect = actionBYeffect
action x resource requirement = actionBYresourceReq
action details = actionDetails
actor x goal = actorBYgoal
actor x resource = actorBYresource
beliefs = beliefs
goal x effect = goalBYeffect
hostility = hostility
influence = influence
injected actions = injectedActions
tendencies = tendencies
tension threshold = tensionThreshold
volatility = volatility

On the left of the above list is the variable names which must be spelled exactly like this. The right side has the table names in the database. These names can be anything as long as they match up with the proper tables in the database.

3.2.2 Client Machine Configuration

To configure a client machine to connect to a MySQL database the MyODBC-3.51.06.exe driver must be installed. This driver can be found on the MySQL website, www.mysql.com. Once the driver is installed it must be configured to use the database:

1. Run the standard windows program “odbcad32.exe” from a command prompt. This will open the “ODBC Data Source Administrator” window.

2. Select the MySQL ODBC driver and hit the “configure...” button. This will open the MyODBC configuration window. The information in this window can be obtained from the MySQL database administrator. Make sure that the info in this window matches the info in the Cores configuration file. Below is a screen shot of the MyODBC window:
3.2.3 MySQL Database Configuration

The database must have tables that match fairly close to the format of the files used in the file input method. The column names of the tables must correspond to the column names used in the csv input files. One problem with MySQL is that it cannot have spaces in column names. This means that quite a few things in the simulation cannot have spaces in the name. These include, effect names, goal names, actor names, action names, and resource names.

An example table in the database is the tendencies table. It must have a column for each action available in the simulation. Each row must start with an actor name and then a varchar for each element of the matrix.

Note that the first column of ALL tables in the database MUST be “START MATRIX.”

3.3 Input File Paths Section

Next is the input file paths section. This section is mandatory. A file must exist for each of these variables in order to do a simulation. Currently all these files need to be csv files. Following is a description of the variables in this section:

- action x effect
This is the name of the file that contains the effects of various actions in the simulation. It is a csv file containing an action by effect matrix such that there are action rows and resource columns. Each element in this matrix indicates how much a resource is incremented or decremented as a result of the corresponding action. For a sample file see actionBYeffect.csv in the Sample Files folder shipped with CORES. Thus the entry for action x effect would look like:
action x effect = actionBYeffect.csv

• action x resource requirement

This is the name of the file that contains the resource requirements for actions. It is a csv file containing an action by resource matrix. This matrix shows how much of each resource is required before an action can be taken. These values should all be positive. These values do not show any information on the effect of an action on resources. It just shows that the resources must exceed a certain level before the action is taken. For a sample file see actionByresourceReq.csv in the Sample Files folder shipped with CORES. Thus the entry for action x resource requirement would look like:
action x resource requirement = actionBYresourceReq.csv

• action details

This is the name of the file that contains the action details. It shows the category, duration, sender, and receivers of each action. The category is currently not used by CORES, but it is required. The four category choices are “Military,” “Financial Economic,” “Humanitarian,” and “Diplomatic.” Duration is the number of time periods required for the action to be deemed complete. Each time period can be viewed as (roughly) equivalent to a day. The sender should be an actor. There must be at least 1 receiver. The first receiver listed is the primary receiver. This is important for hostile actions. For a sample file see actionDetails.csv in the Sample Files folder shipped with CORES. Thus the entry for action details would look like:
action details = actionDetails.csv

• actor x goal

This is the name of the file that contains goal weights for the simulation actors. It is a csv file containing an actor by goal matrix with actor rows and goal columns. Each element of the matrix denotes how important a goal is to the corresponding actor. The more important a goal is the more positive the value. The sum of all the values in a row must equal 1.0.
For a sample file see actorBYgoal.csv in the Sample Files folder shipped with CORES. Thus the entry for actor x goal would look like:
actor x goal = actorBYgoal.csv

• actor x resource
This is the name of the file that contains initial actor resources and their growth rates every time period. If the resource should not grow automatically then make the growth 0.0. For every resource that an actor DOES NOT have, make its value -1.0. For a sample file see actorBYresource.csv in the Sample Files folder shipped with CORES.
Thus the entry for actor x resource would look like:
actor x resource = actorBYresource.csv

- beliefs

This is the name of the file that contains each actor's initial beliefs in the various actions. Currently they are set to 1 indicating that actors are neutral to all actions at the start of the simulation. For a sample file see beliefs.csv in the Sample Files folder shipped with CORES.
Thus the entry for beliefs would look like:
beliefs = beliefs.csv

- goal x effect

This is the name of the file that contains the correlation between goals and effects. The better an effect is for a goal the more positive the value. The worse an effect is for a goal the more negative the value. The rows do not have to sum to one. For a sample file see goalBYeffect.csv in the Sample Files folder shipped with CORES.
Thus the entry for goal x effect would look like:
goal x effect = goalBYeffect.csv

- hostility

This is the name of the file containing the initial actor hostility matrix. It shows an actor's initial hostilities towards other actors. The values must be between -1 and 0 (both inclusive). The more negative a value, the more hostile the row actor is towards the column actor. For a sample file see hostility.csv in the Sample Files folder shipped with CORES.
Thus the entry for hostility would look like:
hostility = hostility.csv

- influence

This is the name of the file containing the initial actor influence matrix. It shows the influence all the actors have on a particular actor. The values must be between 0 and 1 (both inclusive) and rows must sum to one. The more positive a value is the more influence a column actor has on the row actor. For a sample file see influence.csv in the Sample Files folder shipped with CORES.
Thus the entry for influence would look like:
influence = influence.csv
• injected actions

This is the name of the file containing events that should be injected into the simulation at specified time periods. It is not a matrix. There are two types of injected events. Actions can be injected by specifying the time period the action is to happen, the actor who is to take the action, and the action. The other type of injected event is a resource change. The time period, the actor whose resources are to change, the resource, and the amount of change need to be specified. For a sample file see injectedActions.csv in the Sample Files folder shipped with CORES. Thus the entry for injected actions would look like:
injected actions = injectedActions.csv

• tendencies

This is the name of the file containing initial action frequencies for the various actors. The frequencies would typically be based on real life history of the actor. The rows should sum to one. For a sample file see tendencies.csv in the Sample Files folder shipped with CORES. Thus the entry for tendencies would look like:
tendencies = tendencies.csv

• tension threshold

This is the name of the file containing tension threshold values for actors. Threshold is the level of tension that actors are willing to endure before they start taking retaliatory actions. The value should be between 0 and 1 (both inclusive). Actors will take retaliatory actions against other actors whose hostility magnitude go above the tension threshold. For example if actor AAA's hostility toward actor BBB is -0.7999, and actor AAA's tension threshold is 0.8. If actor BBB takes an action toward AAA that takes AAA's hostility toward BBB more negative than -0.8, actor AAA will take a retaliatory action toward BBB. For a sample file see tensionThreshold.csv in the Sample Files folder shipped with CORES. Thus the entry for tension threshold would look like:
tension threshold = tensionThreshold.csv

• volatility = volatility.csv

This is the name of the file containing actor volatility values. Volatility is used after an actor takes a retaliatory action. The more volatile an actor is the more his hostility will go down after he takes a retaliatory action. Volatility must between 0 and 1.0. For a sample file see volatility.csv in the Sample Files folder shipped with CORES. Thus the entry for volatility would look like:
volatility = volatility.csv
4. System Output

The system output consists of information from the simulation at the end of every time period. This allows the researcher to see the order of events and why they came to be. Output will be either a matrix of some kind or some actor relevant information.

Next is a detailed description of the output relevant sections in the configuration file:

4.1 Output Flags Section

The output flags section contains flags to turn on/off different types of output. Most of these have to do with printing. Even though a path to an output file is assigned (discussed in the next section), nothing will be printed into the file unless the proper output flag is set to true. Note that all flags that are not explicitly set to true in the configuration file will be assumed to be false by CORES.

Along with the flags to tell what output to print there are two flags that decide how to print. They are “print names” and “print format.” If “print names” is assigned true then the column and row names of the matrices will be printed each time a matrix is printed to file. This can be useful if the output files will be viewed directly. Printing the row and column names might not be desirable if some statistics program will be used on the output files. “print format” is special in that it does not take true or false values. Instead it takes “CSV” or “NORMAL.” The default is “NORMAL”. This controls what delimiter is used between the fields in the outputs. If “print format” is set to “NORMAL” the delimiter is a space, but if “print format” is set to “CSV” the delimiter will be a comma. Using CSV is recommended if any of the names used in the simulation will have spaces in them. If there are spaces in the names of Actions or Actor names and spaces are used to delimit fields in the output, it makes the output difficult to read. CSV is the recommended format.

“actorResourceFlag” is a special flag inside the output flags section. The format for it is: actorResourceFlag = XXX; true. This tells CORES to print out the resources of actor XXX every time period. There can be more than one actorResourceFlag line depicting a particular actor in the simulation.

4.2 Output File Paths Section

The last section in the configuration file is the output file paths section. An entry for a variable in this section is mandatory only if the corresponding output type flag has been turned on in the previous section. Here is a detailed description of each variable in this section:

- timeSummaryFile

This is the name of the file that contains information on what each actor does each time period. Each entry in the file has the following format:
1, 1, Palestinians, START ACTION Palestinians Call For Support From US, United States, proactive, Probability: 0.234310

The first field indicates the run number which in this case is 1. The next field (separated by a comma) is the time period which is again 1. This is followed by the sending actor i.e. Palestinians. Next are the details of the action that the sending actor takes. This is broken down into two parts: the keyword START ACTION indicates that the actor starts the action in the current time period, followed by the name of the action i.e. START ACTION Palestinians Call For Support From US. The next field is the receiving actor i.e. United States. This field is followed by the field that shows if the action was a proactive action (self benefit action) or a reactive one (retaliatory action). If the action is a proactive action the next field is the probability of the sending actor taking the proactive action and if the action is a reactive one the next field is the hostility of the sending actor towards the receiving actor instead.

Also if an action, which was started previously, ends in a particular time period a similar entry is made into the time summary file with the key words END ACTION instead of START ACTION.

For a sample file see timeSummaryOutput.txt in the Sample Files folder shipped with CORES.

- HostilityMatFile

This is the name of the file to which the actor hostility matrix for every time period is printed.

The first set of entries in this file looks like:

Israel
Hamas
Palestinians
United States

These are the row labels, each label indicating an actor name. Each label is on a new line.

The next set of entries (separated by a blank line from the first set) looks like:

Israel
Hamas
Palestinians
United States

These are the column labels, each label indicating an actor name. Each label is on a new line.
If the “print names” flag in the Output Flags Section of the Configuration file is set to true then the next set of entries (separated by a blank line from the previous set) will look like:

Run: 1  TimePeriod: 1
Israel, Hamas, Palestinians, United States
Israel, 0, -0.8, -0.8, 0
Hamas, -0.8, 0, 0, -0.4
Palestinians, -0.8, 0, 0, 0
United States, 0, -0.6, 0, 0

If the flag is set to false then it looks like:

0, -0.8, -0.8, 0
-0.8, 0, 0, -0.4
-0.8, 0, 0, 0
0, -0.6, 0, 0

In the former case, the run number, time period, row labels, column labels and hostility values are printed. In the latter case only the hostility values are printed. These values are comma separated and should be interpreted as the hostility that the row actor has towards the column actor. This matrix is printed for every time period for every run in the simulation.

NOTE: The first two set of entries are really not very useful and if the user wants can ignore them for the parsers he or she writes to process the output.

For a sample file see hostilityMatOutput.txt in the Sample Files folder shipped with CORES.

- InfluenceMatFile

This is the name of the file to which the actor influence matrix for every time period is printed.

The first set of entries in this file looks like:

Israel
Hamas
Palestinians
United States

These are the row labels, each label indicating an actor name. Each label is on a new line.

The next set of entries (separated by a blank line from the first set) looks like:
These are the column labels, each label indicating an actor name. Each label is on a new line.

If the “print names” flag in the Output Flags Section of the Configuration file is set to true then the next set of entries (separated by a blank line from the previous set) will look like:

Run:1 TimePeriod:1
Israel,Hamas,Palestinians,United States
Israel,0.6,0,0,0.4
Hamas,0,0.5,0.5,0
Palestinians,0,0.3,0.65,0.05
United States,0.3,0,0.1,0.6

If the flag is set to false then it looks like:

0.6,0,0,0.4
0,0.5,0.5,0
0,0.3,0.65,0.05
0.3,0,0.1,0.6

In the former case, the run number, time period, row labels, column labels and influence values are printed. In the latter case only the influence values are printed. These values are comma separated and should be interpreted as the influence that the column actor has on the row actor. This matrix is printed for every time period for every run in the simulation.

NOTE: The first two sets of entries are really not very useful and, if the user wants, can be ignored for parsers to process the output.

For a sample file see influenceMatOutput.txt in the Sample Files folder shipped with CORES.

- BeliefsMatFile

This is the name of the file to which the beliefs matrix for every time period is printed.

The first set of entries in this file looks like:

Israel
Hamas
Palestinians
United States

These are the row labels, each label indicating an actor name. Each label is on a new line.

The next set of entries (separated by a blank line from the first set) looks like:

Israel General Military Action in Palestine
Israel Targeted Military Action Against Palestinian Government
Israel Targeted Military Action Against Hamas
Hamas Suicide Bombing Against Israel
Hamas Assassinate Israeli Leaders
Palestinians Civil Disturbance
USA Provide Material Support To Israel
USA Provide Material Support To Palestinians
Palestinians Provide Support To Hamas
Israel Call for support from US
Hamas Call For Change In Palestinian Leadership
Palestinians Call For Support From US
USA Call For Multilateral Peace Talks With Palestinians and Israel

These are the column labels, each label indicating an action name. Each label is on a new line.

If the “print names” flag in the Output Flags Section of the Configuration file is set to true then the next set of entries (separated by a blank line from the previous set) will look like:

Run:1 TimePeriod:1
Israel General Military Action in Palestine,Israel Targeted Military Action Against Palestinian Government,Israel Targeted Military Action Against Hamas,Hamas Suicide Bombing Against Israel,Hamas Assassinate Israeli Leaders,Palestinians Civil Disturbance,USA Provide Material Support To Israel,USA Provide Material Support To Palestinians,Palestinians Provide Support To Hamas,Israel Call for support from US,Hamas Call For Change In Palestinian Leadership,Palestinians Call For Support From US,USA Call For Multilateral Peace Talks With Palestinians and Israel
Israel,0.52,0.52,0.7,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.46,0.4,0.4,0.4,0.4
Hamas,0.5,0.5,0.5,0.8,0.55,0.5,0.5,0.5,0.5,0.5,0.5,0.5,0.5,0.5
Palestinians,0.35,0.35,0.35,0.35,0.35,0.35,0.61,0.35,0.35,0.61,0.35,0.35,0.35,0.48,0.35
United States,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.7

If the flag is set to false then it looks like:

0.52,0.52,0.7,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.4,0.4
0.5,0.5,0.5,0.8,0.55,0.5,0.5,0.5,0.5,0.5,0.5,0.5,0.5
0.35,0.35,0.35,0.35,0.35,0.35,0.61,0.35,0.35,0.61,0.35,0.35,0.35,0.48,0.35
In the former case, the run number, time period, row labels, column labels and belief values are printed. In the latter case only the belief values are printed. These values are comma separated and should be interpreted as the belief that the row actor has in a column action. This matrix is printed for every time period for every run in the simulation.

NOTE: The first two set of entries are really not very useful and if the user wants can ignore them for the parsers he or she writes to process the output.

For a sample file see beliefsOutput.txt in the Sample Files folder shipped with CORES.

- **ActionTendFile**

This is the name of the file to which the actor's action tendencies every time period are printed.

The first set of entries in this file looks like:

Israel
Hamas
Palestinians
United States

These are the row labels, each label indicating an actor name. Each label is on a new line.

The next set of entries (separated by a blank line from the first set) looks like:

Israel General Military Action in Palestine
Israel Targeted Military Action Against Palestinian Government
Israel Targeted Military Action Against Hamas
Hamas Suicide Bombing Against Israel
Hamas Assasinate Israeli Leaders
Palestinians Civil Disturbance
USA Provide Material Support To Israel
USA Provide Material Support To Palestinians
Palestinians Provide Support To Hamas
Israel Call for support from US
Hamas Call For Change In Palestinian Leadership
Palestinians Call For Support From US
USA Call For Multilateral Peace Talks With Palestinians and Israel

These are the column labels, each label indicating an action name. Each label is on a new line.
If the “print names” flag in the Output Flags Section of the Configuration file is set to true then the next set of entries (separated by a blank line from the previous set) will look like:

Run:1  TimePeriod:1
Israel General Military Action in Palestine,Israel Targeted Military Action Against Palestinian Government,Israel Targeted Military Action Against Hamas,Hamas Suicide Bombing Against Israel,Hamas Assassinate Israeli Leaders,Palestinians Civil Disturbance,USA Provide Material Support To Israel,USA Provide Material Support To Palestinians,Palestinians Provide Support To Hamas,Israel Call for support from US,Hamas Call for Change In Palestinian Leadership,Palestinians Call for Support From US,USA Call for Multilateral Peace Talks With Palestinians and Israel
Israel,0.2,0.2,0.5,0,0,0,0,0,0.1,0,0,0
Hamas,0,0,0,0.6,0.1,0,0,0,0.1,0,0
Palestinians,0,0,0,0,0.4,0,0,0,0.4,0,0,0.2,0
United States,0,0,0,0,0,0.4,0.1,0,0,0,0,0.5

If the flag is set to false then it looks like:

0.2,0.2,0.5,0,0,0,0,0,0.1,0,0,0
0,0,0,0.6,0.1,0,0,0,0.1,0,0
0,0,0,0,0.4,0,0,0,0.4,0,0,0.2,0
0,0,0,0,0,0.4,0.1,0,0,0,0,0.5

In the former case, the run number, time period, row labels, column labels and action tendency values are printed. In the latter case only the action tendency values are printed. These values are comma separated and should be interpreted as the tendency of the row actor to take a column action. This matrix is printed for every time period for every run in the simulation.

NOTE: The first two set of entries are really not very useful and if the user wants can ignore them for the parsers he or she writes to process the output.

For a sample file see actionTendOutput.txt in the Sample Files folder shipped with CORES.

• ProbActionMatFile

This is the name of the file to which the action probabilities for every time period are printed. This is the probability of an actor taking an action based on the proactivity rationale.

The first set of entries in this file looks like:

Israel
Hamas
Palestinians
United States

These are the row labels, each label indicating an actor name. Each label is on a new line.

The next set of entries (separated by a blank line from the first set) looks like:

<table>
<thead>
<tr>
<th>Israel General Military Action in Palestine</th>
<th>Israel Targeted Military Action Against Palestinian Government</th>
<th>Israel Targeted Military Action Against Hamas</th>
<th>Hamas Suicide Bombing Against Israel</th>
<th>Hamas Assasinate Israeli Leaders</th>
<th>Palestinians Civil Disturbance</th>
<th>USA Provide Material Support To Israel</th>
<th>USA Provide Material Support To Palestinians</th>
<th>Palestinians Provide Support To Hamas</th>
<th>Israel Call for support from US</th>
<th>Hamas Call For Change In Palestinian Leadership</th>
<th>Palestinians Call For Support From US</th>
<th>USA Call For Multilateral Peace Talks With Palestinians and Israel</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Run: 1 TimePeriod: 1" /></td>
<td>Israel General Military Action in Palestine, Israel Targeted Military Action Against Palestinian Government, Israel Targeted Military Action Against Hamas, Hamas Suicide Bombing Against Israel, Hamas Assasinate Israeli Leaders, Palestinians Civil Disturbance, USA Provide Material Support To Israel, USA Provide Material Support To Palestinians, Palestinians Provide Support To Hamas, Hamas Call For Change In Palestinian Leadership, Palestinians Call For Support From US, USA Call For Multilateral Peace Talks With Palestinians and Israel</td>
<td>Israel, 0.196248, 0.189152, 0.376074</td>
<td>0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.238526, 0, 0</td>
<td>0, 0, 0, 0.54065, 0.33952, 0, 0, 0, 0, 0, 0, 0, 0.119831, 0, 0</td>
<td>0, 0, 0, 0, 0, 0.382845, 0, 0, 0.382845, 0, 0, 0, 0.23431, 0</td>
<td>0, 0, 0, 0, 0, 0, 0, 0.290702, 0.250387, 0, 0, 0, 0, 0.45891</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If the “print names” flag in the Output Flags Section of the Configuration file is set to true then the next set of entries (separated by a blank line from the previous set) will look like:

<table>
<thead>
<tr>
<th>Run: 1 TimePeriod: 1</th>
<th>Israel General Military Action in Palestine, Israel Targeted Military Action Against Palestinian Government, Israel Targeted Military Action Against Hamas, Hamas Suicide Bombing Against Israel, Hamas Assasinate Israeli Leaders, Palestinians Civil Disturbance, USA Provide Material Support To Israel, USA Provide Material Support To Palestinians, Palestinians Provide Support To Hamas, Hamas Call For Change In Palestinian Leadership, Palestinians Call For Support From US, USA Call For Multilateral Peace Talks With Palestinians and Israel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel, 0.196248, 0.189152, 0.376074, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.238526, 0, 0</td>
<td>0, 0, 0, 0.54065, 0.33952, 0, 0, 0, 0, 0, 0, 0, 0.119831, 0, 0</td>
</tr>
<tr>
<td>0, 0, 0, 0, 0.382845, 0, 0, 0.382845, 0, 0, 0, 0, 0.23431, 0</td>
<td>0, 0, 0, 0, 0, 0.290702, 0.250387, 0, 0, 0, 0, 0.45891</td>
</tr>
</tbody>
</table>

If the flag is set to false then it looks like:

0.196248, 0.189152, 0.376074, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.238526, 0, 0
0, 0, 0, 0.54065, 0.33952, 0, 0, 0, 0, 0, 0, 0, 0.119831, 0, 0
0, 0, 0, 0, 0.382845, 0, 0, 0.382845, 0, 0, 0, 0.23431, 0
In the former case, the run number, time period, row labels, column labels and action probabilities are printed. In the latter case only the action probabilities are printed. These probabilities are comma separated and should be interpreted as the probability of the row actor taking a column action. This matrix is printed for every time period for every run in the simulation.

NOTE: The first two set of entries are really not very useful and if the user wants can ignore them for the parsers he or she writes to process the output.

For a sample file see probActionMatOutput.txt in the Sample Files folder shipped with CORES.

- ActBenefitMatFile

This is the name of the file to which the action benefit matrix is printed. The action benefit matrix denotes how beneficial an action is to the actor in terms of getting the actor closer to its goals.

The first set of entries in this file looks like:

Israel
Hamas
Palestinians
United States

These are the row labels, each label indicating an actor name. Each label is on a new line.

The next set of entries (separated by a blank line from the first set) looks like:

Israel General Military Action in Palestine
Israel Targeted Military Action Against Palestinian Government
Israel Targeted Military Action Against Hamas
Hamas Suicide Bombing Against Israel
Hamas Assasinate Israeli Leaders
Palestinians Civil Disturbance
USA Provide Material Support To Israel
USA Provide Material Support To Palestinians
Palestinians Provide Support To Hamas
Israel Call for support from US
Hamas Call For Change In Palestinian Leadership
Palestinians Call For Support From US
USA Call For Multilateral Peace Talks With Palestinians and Israel
These are the column labels, each label indicating an action name. Each label is on a new line.

If the “print names” flag in the Output Flags Section of the Configuration file is set to true then the next set of entries (separated by a blank line from the previous set) will look like:

Run: 1  TimePeriod: 1
Israel General Military Action in Palestine, Israel Targeted Military Action Against Palestinian Government, Israel Targeted Military Action Against Hamas, Hamas Suicide Bombing Against Israel, Hamas Assassinate Israeli Leaders, Palestinians Civil Disturbance, USA Provide Material Support To Israel, USA Provide Material Support To Palestinians, Palestinians Provide Support To Hamas, Israel Call for support from US, Hamas Call For Change In Palestinian Leadership, Palestinians Call For Support From US, USA Call For Multilateral Peace Talks With Palestinians and Israel
Israel, 0.0723644, 0.0697479, 0.103015, 0.0661409, 0.0667576, 0.0889603, 0.0886239, 0.0749808, 0.0994262, 0.0811483, 0.0960996, 0.0927355
Hamas, 0.0455492, 0.0296314, 0.078609, 0.164075, 0.149871, 0.186972, 0.0538754, 0.0577936, 0.106771, 0.0528958, 0.0553447, 0.0186115
Palestinians, 0.0374532, 0.0299625, 0.183521, 0.082397, 0.101124, 0.071161, 0.071161, 0.101124, 0.0898876, 0.082397, 0.0786517, 0.071161
United States, 0.121048, 0.0729111, 0.0949646, 0.0635971, 0.0408942, 0.0749485, 0.0898151, 0.047723, 0.106294, 0.0830982, 0.0965319, 0.108174

If the flag is set to false then it looks like:

0.0723644, 0.0697479, 0.103015, 0.0661409, 0.0667576, 0.0889603, 0.0886239, 0.0749808, 0.0994262, 0.0811483, 0.0960996, 0.0927355
0.0455492, 0.0296314, 0.078609, 0.164075, 0.149871, 0.186972, 0.0538754, 0.0577936, 0.106771, 0.0528958, 0.0553447, 0.0186115
0.0374532, 0.0299625, 0.183521, 0.082397, 0.101124, 0.071161, 0.071161, 0.101124, 0.0898876, 0.082397, 0.0786517, 0.071161
0.121048, 0.0729111, 0.0949646, 0.0635971, 0.0408942, 0.0749485, 0.0898151, 0.047723, 0.106294, 0.0830982, 0.0965319, 0.108174

In the former case, the run number, time period, row labels, column labels and action benefit values are printed. In the latter case only the action benefit values are printed. These values are comma separated and should be interpreted as how beneficial is the column action for the row actor.

NOTE: Although this matrix is printed for every time period for every run in the simulation its value remains constant throughout, as of now. Latter versions might have different values for different time periods.
NOTE: The first two set of entries are really not very useful and if the user wants can ignore them for the parsers he or she writes to process the output.

For a sample file see actBenefitMatOutput.txt in the Sample Files folder shipped with CORES.

- **ActorResourceFile**

This is a special variable. It allows the printing of a specific actor's resources. The value for this variable has a special format. The format is ActorName;outputFile e.g. AAA;recourcesForAAA.txt. The ActorName part of the value MUST be exactly as it appears in the input files. If the actor's name is “Henry” in the input files, “henry” would be considered a different actor here. The output filename is the same as the other output filenames.

There should be an ActorResourceFile variable for EACH actor whose resources need to be printed. Each actor gets his own resource output file so if there are actors: Henry, Bob, Lisa, Sherry in the demo and the resources for each need to be printed, something like this would be necessary:

ActorResourceFile = Henry;henryRecFile.txt
ActorResourceFile = Bob;bobRecFile.txt
ActorResourceFile = Lisa;lisaRecFile.txt
ActorResourceFile = Sherry;sherryRecFile.txt

Note how the ActorResourceFile variable repeats.

The first set of entries in an actor resource file will look like:

Run Number,1
Time Period,1
Hamas Money,0.000000
Hamas Personnel,0.800000
Hamas Weapons,0.500000
Israeli Land,-1.000000
Israeli Money,-1.000000
Israeli Personnel,-1.000000
Israeli Security,-1.000000
Israeli Weapons,-1.000000
Palestinian Land,-1.000000
Palestinian Money,-1.000000
Palestinian Personnel,-1.000000
Palestinian Security,-1.000000
US Money,-1.000000
US Power in Region,-1.000000
Thus the run number, time period, resource names and values are printed. These entries are printed for every time period for every run.

For a sample file see HamasResources.txt in the Sample Files folder shipped with CORES.

5. System Requirements

CORES will run on any machine with any Microsoft OS, FreeBSD, or Linux. CORES is only limited by the memory and processor speed of the machine. A faster machine will enable cores to finish faster. A significant amount of matrix multiplication is performed in CORES so a 1.0 GHz or above processor with 256 MB of RAM is recommended.

6. Performance Characteristics

Table 1: Performance Characteristics

<table>
<thead>
<tr>
<th>Actors</th>
<th>Resources</th>
<th>Goals</th>
<th>Actions</th>
<th>No of Runs</th>
<th>No of Time Periods</th>
<th>Running Time</th>
<th>Output Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>22</td>
<td>9</td>
<td>21</td>
<td>1</td>
<td>10</td>
<td>1.29 seconds</td>
<td>238KB</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>9</td>
<td>21</td>
<td>1</td>
<td>50</td>
<td>6.18 seconds</td>
<td>1.1MB</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>9</td>
<td>21</td>
<td>1</td>
<td>100</td>
<td>12.38 seconds</td>
<td>2.2MB</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>9</td>
<td>21</td>
<td>10</td>
<td>10</td>
<td>12.42 seconds</td>
<td>2.1MB</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>9</td>
<td>21</td>
<td>10</td>
<td>50</td>
<td>1 min 05 seconds</td>
<td>11MB</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>9</td>
<td>21</td>
<td>10</td>
<td>100</td>
<td>2 min 01 seconds</td>
<td>21MB</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>9</td>
<td>21</td>
<td>25</td>
<td>10</td>
<td>33 seconds</td>
<td>5.2MB</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>9</td>
<td>21</td>
<td>25</td>
<td>50</td>
<td>2 min 39 seconds</td>
<td>26MB</td>
</tr>
<tr>
<td>6</td>
<td>22</td>
<td>9</td>
<td>21</td>
<td>25</td>
<td>100</td>
<td>5 min 13 seconds</td>
<td>52MB</td>
</tr>
</tbody>
</table>

7. Illustrative Samples

7.1 Execute Sample Scenario

Here is an example of how to setup and run a scenario with CORES. The input data for this scenario is found in Appendix A. This example shows how to configure and run cores for FILE based input. However, scripts to create a mysql database with the same input are available in Appendix B.

The first thing that must be done is to create the input files and configure CORES. Copy the data from each table in Appendix A into individual files. Put these files into a directory. Use the path to this directory as the “input directory” variable in the config file. Create a directory for output and add its path to the config file for the “output directory” variable. Add each filename to the corresponding variable under the “INPUT FILE PATHS” section of the config file. Set the number of runs and time periods in the config file. Don’t forget to use FILES as the “input type” variable. Also be sure to select the outputs.

To run CORES either drag and drop the config file onto the CORES executable or run cores from the command line and pass the path to the config file as a parameter.
CORES will run showing output in the console window. When it is finished all of its output along with a copy of the config file will be found in the directory pointed to by the “output directory” variable. These files can be processed by another application or they can be opened and viewed in any text editor.

7.2 Explanation of Results
Here is an explanation of certain output from the above scenario.

In a typical scenario, as actors interact they will become hostile towards each other at certain time periods. When the hostility becomes too great they will take actions towards the actors whom they are hostile to. After hostile actions are taken the hostility level will subside and they return to the normal action taking sequence. Below is a figure, from a sample scenario, showing how hostility towards Hamas oscillates for Israel.

![Figure 4: Israeli Hostility Towards Hamas](image)

The actors have beliefs in actions. As time passes the beliefs in actions will change depending on how the simulation is going. The figure below shows Israel’s belief in asking the US for help grow and surpass Israel’s belief in attacking Hamas directly.
Figure 5: Israeli Belief in Israeli Actions

8. Sample Input

Table 2: Influence:

<table>
<thead>
<tr>
<th>START MATRIX</th>
<th>Israel</th>
<th>Hamas</th>
<th>Palestinians</th>
<th>United States</th>
<th>Regional Arab Powers</th>
<th>United Nations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel</td>
<td>0.6</td>
<td>0</td>
<td>0</td>
<td>0.4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hamas</td>
<td>0</td>
<td>0.4</td>
<td>0.3</td>
<td>0</td>
<td>0.3</td>
<td>0</td>
</tr>
<tr>
<td>Palestinians</td>
<td>0</td>
<td>0.2</td>
<td>0.55</td>
<td>0.05</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>United States</td>
<td>0.2</td>
<td>0</td>
<td>0.1</td>
<td>0.5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Regional Arab Powers</td>
<td>0</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
<td>0.4</td>
<td>0</td>
</tr>
<tr>
<td>United Nations</td>
<td>0</td>
<td>0</td>
<td>0.1</td>
<td>0.4</td>
<td>0.5</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 3: Hostility:

<table>
<thead>
<tr>
<th>START MATRIX</th>
<th>Israel</th>
<th>Hamas</th>
<th>Palestinians</th>
<th>United States</th>
<th>Regional Arab Powers</th>
<th>United Nations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel</td>
<td>0</td>
<td>-0.4</td>
<td>-0.4</td>
<td>0</td>
<td>-0.2</td>
<td>0</td>
</tr>
<tr>
<td>Hamas</td>
<td>-0.4</td>
<td>0</td>
<td>0</td>
<td>-0.2</td>
<td>0</td>
<td>-0.2</td>
</tr>
<tr>
<td>Palestinians</td>
<td>-0.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>United States</td>
<td>0</td>
<td>-0.2</td>
<td>0</td>
<td>0</td>
<td>-0.1</td>
<td>0</td>
</tr>
<tr>
<td>Regional Arab Powers</td>
<td>-0.2</td>
<td>0</td>
<td>0</td>
<td>-0.1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>United Nations</td>
<td>0</td>
<td>-0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4: Volatility:

<table>
<thead>
<tr>
<th>START MATRIX</th>
<th>Volatility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel</td>
<td>0.8</td>
</tr>
</tbody>
</table>
Hamas 0.8  
Palestinians 0.2  
United States 0.8  
Regional Arab Powers 0.5  
United Nations 0.5  

Table 5: Tension Threshold:  

<table>
<thead>
<tr>
<th>START MATRIX</th>
<th>tension Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Israel</td>
<td>0.8</td>
</tr>
<tr>
<td>Hamas</td>
<td>0.8</td>
</tr>
<tr>
<td>Palestinians</td>
<td>0.8</td>
</tr>
<tr>
<td>United States</td>
<td>0.8</td>
</tr>
<tr>
<td>Regional ArabPowers</td>
<td>0.8</td>
</tr>
<tr>
<td>United Nations</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Table 6: Pause Injections:  

<table>
<thead>
<tr>
<th>START MATRIX</th>
<th>Action Name</th>
<th>Resource Name value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTION 0 INJECTION 20</td>
<td>Hamas</td>
<td>Hamas Call For Change In Palestinian Leadership</td>
</tr>
</tbody>
</table>

Table 7: Goal x Effect:
<table>
<thead>
<tr>
<th>Maximize UN Influence</th>
<th>Achieve Palestinian Sovereignty</th>
<th>Maximize Arab Influence</th>
<th>Maintain Israeli-Palestinian Relations</th>
<th>Stop Termination</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>-0.2</td>
<td>-0.5</td>
<td>-0.5</td>
<td>0.2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>0.3</td>
<td></td>
<td></td>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>

START MATRIX

CMU SCS ISRI

CASOS Report
<table>
<thead>
<tr>
<th></th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>0.2</td>
<td>Palestinian land</td>
</tr>
</tbody>
</table>

**CMU SCS ISRI CASOS Report 33**
|                | United Nations | Regional Arab Powers | Israel | Jordan | Lebanon | Syria | Iraq | Iran | Turkmenistan | Pakistan | Total | Total
|----------------|----------------|---------------------|-------|-------|--------|-------|------|------|-------------|----------|-------|-------
| Israel Money   | 0.001          | 0.001               |       |       |        |       |      |     | 0.001       | 0.001    | 0     | 0.001 |
| Israel Land    | 0.001          | 0.001               |       |       |        |       |      |     | 0.001       | 0.001    | 0     | 0.001 |
| Israel Security| 0.001          | 0.001               |       |       |        |       |      |     | 0.001       | 0.001    | 0     | 0.001 |
| Israel Growth  | 0.001          | 0.001               |       |       |        |       |      |     | 0.001       | 0.001    | 0     | 0.001 |
| Israel Money   | 0.001          | 0.001               |       |       |        |       |      |     | 0.001       | 0.001    | 0     | 0.001 |
| Israel Land    | 0.001          | 0.001               |       |       |        |       |      |     | 0.001       | 0.001    | 0     | 0.001 |
| Israel Security| 0.001          | 0.001               |       |       |        |       |      |     | 0.001       | 0.001    | 0     | 0.001 |
| Israel Growth  | 0.001          | 0.001               |       |       |        |       |      |     | 0.001       | 0.001    | 0     | 0.001 |

Table 8: Actor Resource
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Actor</td>
<td>Goal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hamas</td>
<td>Palestinian</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>United Nations</td>
<td>United States</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Regional Arab Powers</td>
<td>Israel</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Stop Terrorism</td>
<td>Maintain Israeli-Palestinian Relations</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Achieve Palestinian Sovereignty</td>
<td>Maximize Israel-Casseilles</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Maximize Arab Influence</td>
<td>Weaken Israel</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Maximize US Influence</td>
<td>Maximize Palestinian Casualties</td>
<td>Maximize UN Influence</td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------</td>
<td>---------------------------------</td>
<td>-----------------------</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>United Nations</td>
<td>Regional and Powers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>Palestinian</td>
<td>Hamas</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0.2</th>
<th>Israel</th>
<th>Palestinian</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>Hamas Call for Support</td>
<td>Palestinian Leadership</td>
</tr>
<tr>
<td>0.0</td>
<td>Palestinian for Change in</td>
<td>Israel Against</td>
</tr>
<tr>
<td>0.0</td>
<td>Gaza</td>
<td>Palestinian Action</td>
</tr>
<tr>
<td>0.0</td>
<td>Hamas</td>
<td>Palestinian Action</td>
</tr>
<tr>
<td>0.0</td>
<td>Israel Targeted</td>
<td>Palestinian Action</td>
</tr>
<tr>
<td>0.0</td>
<td>Israel Targeted</td>
<td>Palestinian Action</td>
</tr>
</tbody>
</table>

START MATRIX
<table>
<thead>
<tr>
<th>01</th>
<th>02</th>
<th>03</th>
<th>04</th>
<th>05</th>
<th>06</th>
<th>07</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN Call for Palestinian Peace Talks and Regional Powers Call for Regional and Israeli Support to Palestinian Miltary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palestinian-support and Israeli Support to Palestinian Miltary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US and Regional Powers Call for Regional and Israeli Support to Palestinian Miltary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Israeli Support to Palestinian Miltary</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palestinian Support to Military</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palestinian Peace Talks and Regional Powers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palestinian Peace Talks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>United Nations</td>
<td>Regional Arab Powers</td>
<td>Palestine</td>
<td>Hamas</td>
<td>Israeli</td>
<td>START WATIIIX</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------</td>
<td>----------------------</td>
<td>-----------</td>
<td>-------</td>
<td>---------</td>
<td>---------------</td>
</tr>
<tr>
<td>Hamas Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palestinian</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From US</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Call</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For Change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hamas Call</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Israeli Target</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Action</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palestine</td>
<td>Peace Talks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Send</td>
<td>Y. Arab Internationl Peace Support</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regional Power Call For</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Israel Support To</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multilateral Peace Talks With</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regional Power Call For</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Israel Support To</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multilateral Action</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>USA Provide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Israel Support To</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multilateral Peace Talks With</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>USA Provide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Israeli Support To</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multilateral Peace Talks With</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>USA Provide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disturbance</td>
<td>Israel Support To</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multilateral Peace Talks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>USA Provide</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
UN Send Peacekeeping Force To Israel
<table>
<thead>
<tr>
<th>Action</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN Sanctions</td>
<td>Force to Palestinian Authority</td>
</tr>
<tr>
<td>UN Call for International Attention</td>
<td>Palestinian Human Rights</td>
</tr>
<tr>
<td>Regional Aid</td>
<td>Provide Material Support to Palestinians</td>
</tr>
<tr>
<td>Regional Aid</td>
<td>Provide Material Support to Israelis</td>
</tr>
<tr>
<td>USA Aid</td>
<td>Action Against Regional Aid Powers</td>
</tr>
<tr>
<td>USA Aid</td>
<td>Provided Material Support to Israelis</td>
</tr>
<tr>
<td>USA Aid</td>
<td>Provided Material Support to Palestinians</td>
</tr>
<tr>
<td>Israeli Officials</td>
<td>Call for Sanctions Against Palestinian Leaders</td>
</tr>
<tr>
<td>Israeli Officials</td>
<td>Call for Support from Regional Aid Powers</td>
</tr>
<tr>
<td>Israeli Officials</td>
<td>Call for Change in Palestinian Leadership</td>
</tr>
<tr>
<td>Israeli Officials</td>
<td>Support for Israel</td>
</tr>
<tr>
<td>Israeli Officials</td>
<td>Treadget Military Action Against Hamas</td>
</tr>
<tr>
<td>Israeli Officials</td>
<td>Treadget Military Action Against Palestinian Government</td>
</tr>
<tr>
<td>Israeli Money</td>
<td>Support for Israel</td>
</tr>
<tr>
<td>Israeli Security</td>
<td>Support for Israeli Security</td>
</tr>
<tr>
<td>Israeli Weapons</td>
<td>Support for Israeli Weapons</td>
</tr>
<tr>
<td>Israel Land</td>
<td>Support for Israel Land</td>
</tr>
<tr>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>---</td>
<td>------</td>
</tr>
<tr>
<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>Category</td>
<td>Action Details</td>
</tr>
<tr>
<td>----------</td>
<td>----------------</td>
</tr>
<tr>
<td>Military</td>
<td>UN Send Peacekeeping Force to Israel</td>
</tr>
<tr>
<td>Diplomatic</td>
<td>UN Call for Internationally Recognized Peace Talks</td>
</tr>
<tr>
<td>Regional &amp; Aid Powers</td>
<td>Provide economic support to Palestinians and Israeli</td>
</tr>
<tr>
<td>Financial Aid</td>
<td>USA Military Action Against Regional &amp; Aid Powers</td>
</tr>
<tr>
<td>USA Provides Material Support to Palestinians</td>
<td></td>
</tr>
<tr>
<td>USA Call for Multilateral Peace Talks With Palestinians and Israeli</td>
<td></td>
</tr>
<tr>
<td>Palestinian Call for Support From US</td>
<td></td>
</tr>
<tr>
<td>Hamas Assists Israeli Leaders</td>
<td></td>
</tr>
<tr>
<td>Hamas Calls for Change in Palestinian Leadership</td>
<td></td>
</tr>
<tr>
<td>Israeli Call for Support from US</td>
<td></td>
</tr>
<tr>
<td>Israeli Targeted Military Action Against Hamas</td>
<td></td>
</tr>
<tr>
<td>Israeli Targeted Military Action Against Palestinian Government</td>
<td></td>
</tr>
<tr>
<td>Israeli General Military Action in Palestine</td>
<td></td>
</tr>
<tr>
<td>Action</td>
<td>Resource</td>
</tr>
<tr>
<td>--------</td>
<td>----------</td>
</tr>
<tr>
<td>Provide Material Support to Palestinians</td>
<td>USA</td>
</tr>
<tr>
<td>Provide Material Support to Palestinians</td>
<td>USA</td>
</tr>
<tr>
<td>Provide Military Support to Palestinians</td>
<td>USA</td>
</tr>
<tr>
<td>Provide Military Support to Palestinians</td>
<td>USA</td>
</tr>
<tr>
<td>Call for Palestinian-Palestinian Talks</td>
<td>USA</td>
</tr>
<tr>
<td>Call for Palestinian-Palestinian Talks</td>
<td>USA</td>
</tr>
<tr>
<td>Call for Palestinian-Palestinian Talks</td>
<td>USA</td>
</tr>
<tr>
<td>Call for Palestinian-Palestinian Talks</td>
<td>USA</td>
</tr>
<tr>
<td>Palestine Signing Agreement with Israel</td>
<td>USA</td>
</tr>
<tr>
<td>Palestine Signing Agreement with Israel</td>
<td>USA</td>
</tr>
</tbody>
</table>
### Table 15: Injected Actions

<table>
<thead>
<tr>
<th>Injecting Actor Name</th>
<th>Sending Actor Name</th>
<th>Time Period</th>
<th>Inject</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamas</td>
<td>Palestine Money</td>
<td>2000-2001</td>
<td>1</td>
<td>Action Injection against Hamas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100</td>
<td>1</td>
<td>Action Injection against Hamas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100</td>
<td>0</td>
<td>Action Injection against Hamas</td>
</tr>
</tbody>
</table>

START MATRIX 1

END MATRIX 1