

MOVES Training

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Expected Preparation

- Software installed (Java, MySQL & MOVES).
- Basic familiarity with the Windows operating system.
 - How to start a command prompt.
 - How to use Window Explorer.
- How to use Notepad or another text editor.
- Some familiarity with mobile source modeling (such as MOBILE6).

Course Objectives

- In this course, you will learn how to
 - Install MOVES (Done—Congratulations!).
 - Run MOVES from the GUI.
 - View and post-process output.
 - Edit, save, and modify Run Specifications.
 - Use the summary reporter to generate output reports.
 - Provide detailed user input data to MOVES.
 - Access the additional features of MOVES.

Course Objectives (cont.)

- Along the way, you will learn a little about how MOVES works
- Because MOVES is a little complicated and not idiot proof, you need to understand a little of how it works in order to troubleshoot your runs and look at its output critically.
- This training is not a substitute for reading the MOVES User Guide.

Other potential topics, time permitting

- Whatever you would like!
- Configure MOVES.
- Look at distributed processing.
- Run MOVES from a command line.

Logistics

- Hours: 1:00 AM - 5:00 PM
- One break
- Please turn off or set pagers and cell phones on vibrate
- If you need to talk on your cell phone, please leave the room.

Logistics (cont.)

- For the hands-on exercises, I'll explain how to do it, then you do it, then I'll do it.
 - So pay attention rather than typing along.
 - Work together – you'll learn more.
 - If you finish an exercise, please help others who are having trouble.
 - Ask questions if you get stuck.
 - I'll be here after the session and tomorrow.

Questions

- Feel free to ask at any time--*if you are confused, so are other people!*
- The answer may be
 - I'll cover that later.
 - I don't know.
 - Out of the scope.
 - My brother knows the answer to that one.

Miscellaneous

- Download the latest software and database:
<http://www.epa.gov/otaq/ngm.htm>
- Important: subscribe to the mobile source listserver to learn about updates, bugs, fixes for MOVES.
- We won't be able to cover everything.
- I'll be around after the session.
- You can ask questions later by phone or email.

Resources

- Handouts—These Slides.
- The MOVES User Guide is in the Help menu of the MOVES GUI or can be printed from the Acrobat PDF provided with the software.
- MOVES Documentation at: <http://www.epa.gov/otaq/ngm.htm>, including the Software Design & Reference Manual.
- Mobile Source listserver.
- Email mobile@epa.gov

What is MOVES?

- The **MO**tor **V**ehicle **E**missions **S**imulator
 - a consolidated emissions modeling system for onroad and nonroad emission inventories.
- Main use case:
 - Currently: MOVES2004 estimates energy usage.
 - Ultimately will replace MOBILE6 and NONROAD models.
- Combines a Java™ framework with a national county database.
- Capable of stand-alone or distributed processing.

What is MOVES HVI Demo?

- Highway Vehicle Implementation (HVI).
- This demonstration version of the MOVES model contains only placeholder data values.
- The MOVES model GUI and these values will be changed in the final release.
- MOVES HVI Demo (and MOVES2004) are not approved for official purposes.
- MOBILE6.2 is still the official EPA model.

Will I need further training?

- This training only addresses the MOVES HVI Demonstration version.
- This training will not cover any issues with the MOVES2004 version.
- Changes are likely and additional training may be needed when the final version of MOVES is released.

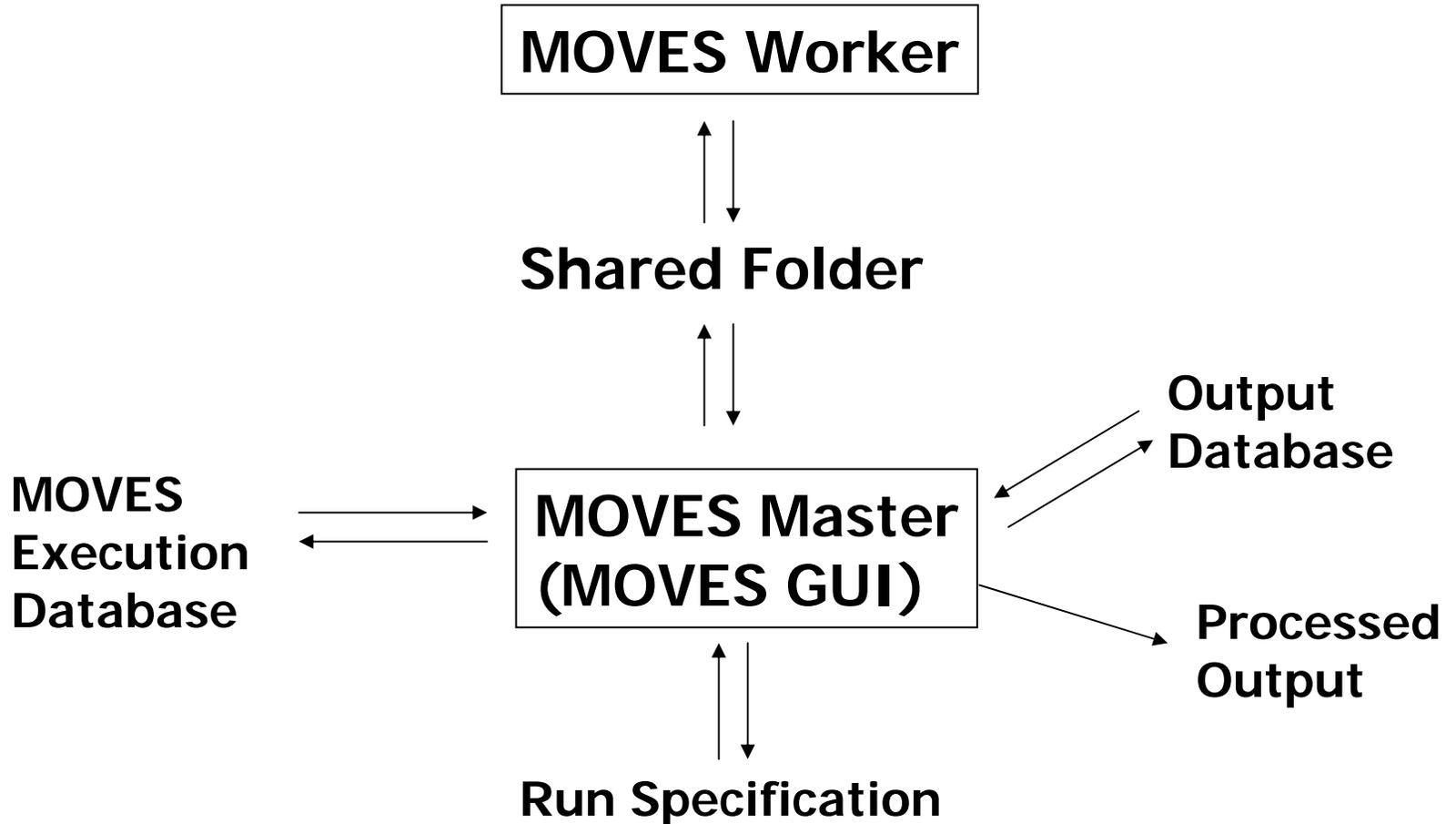
Changes Since MOVES2004

- Upgrade to Java 1.4.2_03
- Upgrade to MySQL
- New Features
 - Additional pollutants and processes.
 - Output summary reporting options.
 - Emission rate output option.
 - Pre-processor for I/M inputs.
 - Trip information input processing.
 - Performance features.
- Many more changes will occur!

State of the software

- The most reliable functions are those already available using MOVES2004.
- MOVES is still primarily a macroscale model.
- The emission rates are still being changed and developed.
- Not idiot-proof—it helps to understand how it works.

How MOVES Works



MOVES Default Database

- Similar to NMIM County Database.
- Includes county specific data:
 - Temperatures, relative humidity.
 - Fuel properties (gasoline and diesel).
 - Vehicle activity.
- Also, includes all national default values:
 - Emission rates and age deterioration.
 - Growth rates.
 - Vehicle technologies.
 - Adjustments for temperatures, humidity, fuels, etc.

Domain

- Domain refers to the area to which “area wide” parameters apply.
- Some parameters are only allowed at a domain wide level.
- It may be necessary to have separate MOVES run specifications for areas using parameters that vary, but are only allowed at a domain wide level.
- Multiple MOVES run specifications can be run at once by running MOVES from a command line.

Exercise 1: Start Master Using Desktop Icon

- Start the Master using the desktop icon.
 - Notice the console window associated with the MOVES window.
- Stop the Master.
 - Note that console window closed.
- If no Worker is present, one will automatically be started.

Help Menu

- "About MOVES" will tell you your version of the software.
- MOVES User's Guide
 - Also stored as an Adobe Acrobat PDF.
 - PDF is located in the Help subdirectory of the MOVES installation.
- MOVES Software Design/Reference Manual
 - Detailed description of how MOVES is works.
 - Also available as a PDF document.

Exercise 2: Create, Save, and Reload a RunSpec

- Start Master
 - Green check means input is ready.
 - Red exclamation indicates more information is needed.
 - Wavy lines means no input is necessary.
- Description - Enter a brief description (optional)
 - This description will appear only in the RunSpec.
 - Do not use the five XML reserved characters: ' " < > &

Exercise 2: RunSpec Scale

- Scale relates to geographic detail:
 - “Macro” scale looks at counties with roadways aggregated.
 - “Meso” scale looks at counties or sub-county zones, with individual link specific results.
 - “Micro” scale looks at individual intersections or small portions of zones or roadways.
- MOVES HVI Demo is primarily a macroscale model.
- We are beginning to develop a mesoscale “look up” table option.
- Choose Macroscale

Pre-Aggregation

- MOVES calculations take a long time.
- Aggregation of inputs is one way to reduce the number of calculations and speed up a run.
- Aggregation of inputs is not the same as aggregation of the outputs and will result in different results.
- Proper aggregation is a policy issue and will be addressed in guidance.

Exercise 2:

RunSpec Geography

- Geography – experiment with different options:
 - Region aggregates the inputs. Choose County.
 - Select only one or two counties.
 - Select Cook County, Illinois, or any other area with an I/M program (for use later).

Exercise 2: RunSpec (cont.)

- Time – experiment with this screen:
 - Time Aggregation Level aggregates inputs. Choose Hour.
 - Choose a single year: Select 1999, click Add, check July.
 - Choose a day type: Select Weekdays.
 - Choose a single hour: Select 12:00 – 12:59 for both Start and End Hour.
- Vehicles/Equipment
 - Only onroad vehicles are available.
 - Experiment with this screen.
 - Choose a single vehicle class: Select Gasoline/Passenger Car
 - Add Fuel/Type Combinations

Road Types

- Rural Restricted Access (freeway)
- Rural Unrestricted Access
- Urban Restricted Access (freeway)
- Urban Unrestricted Access
- Off-Network
 - The “off network” road type is a catch-all for any highway vehicle emissions that are not directly associated with specific roads on the network roadways.
- Select urban unrestricted access.

Pollutant Processes

- Multiple processes can produce the same pollutant. (for example, gasoline evaporation and engine exhaust both produce HC emissions.)
- Each process will have different emission rates and results.
- Processes are always computed separately, but the results can be aggregated in the results.

Exercise 2: RunSpec (cont.)

- Pollutants and Processes – Experiment:
 - Options scroll off-screen to the right.
 - Select pollutants oxides of nitrogen (NO_x) and carbon monoxide (CO) under the Running Exhaust process.
 - Check the “Distance Traveled” box to get VMT.

Exercise 2: RunSpec (cont.)

- Manage Input Data Sets – None.
 - All data inputs are located in MySQL tables.
 - Multiple input databases can be used simultaneously.
 - Database Server: localhost
 - Start by using the default values. We'll talk about inputs later.

Exercise 2: RunSpec (cont.)

- Strategies – None.
 - Now: Alternative Vehicle Fuels & Technologies.
 - Other strategy use cases will be added here.
- General Output
 - Create output database: Test1
 - Select Output Units: U.S. Tons, Kilojoules, Miles.
 - Server can be blank or localhost.

Exercise 2: RunSpec (cont.)

- Output Emissions Detail
 - Determines the amount of output aggregation.
 - Select Hour and County.
 - Select SCC, Model Year and Emission Process.
 - Estimate Uncertainty – Monte Carlo simulation. Not now.

Exercise 2: RunSpec (cont.)

- Advanced Performance Features
 - This is an advanced feature primarily to reduce run time.
 - Save Data prevents MOVES from destroying intermediate result values from the MOVES execution database.
 - Don't Execute assumes that the results are already available in the input database or will not be needed for the final results.
 - Don't use this feature until you understand it.

Exercise 2: RunSpec (cont.)

- Save RunSpec -
 - Suggestion: Make a directory: RunSpecs
 - Suggested RunSpec name: test1.mrs
- Close RunSpec (File, Close)
- Reload RunSpec (File, Open)—are your saved choices still there?
- Are there only green check marks?

Exercise 3: Execute

- Select “Action” from top-level menu
- Click Execute. (Always save the RunSpec.)
- A Worker application will appear, unless one has already been started.
- Run is complete when navigation list returns (mine took 13 minutes).
- Select Action, MOVES Run Error Log—any errors?

MySQL

- The MOVES input database is in MySQL
- MOVES output is in MySQL
- Documentation on your hard drive:
c:\MySQL\Docs
- Web URL: www.mysql.com
- Worth understanding at least a little about it
- Putting C:\mysql\bin in your path will allow you to run from DOS from any directory.

Structure of MySQL Databases

- C:\MySQL\data
- Each folder is a separate database.
- Each table consists of three files:
 - .MYD - the data
 - .MYI - the index
 - .frm - the format
- To copy a table you must copy all three files.

MySQL Query Browser

- A handy utility for examining MySQL Databases and tables.
- Can modify individual entries in tables.
- Using MySQL scripts superior because:
 - You can quickly modify many entries.
 - Scripts provide a record of what you did.
- See installation ReadMe.doc for installation and startup.
- Supported by MySQL.

Exercise 4: Where is the output?

(Introduction to MOVES's MySQL databases.)

- Open MySQL Query Browser, a handy utility for examining MySQL databases.
- Find your output database: test1
- What are the six output database tables?
 - How many records are in each table?
 - What are the fields of each table?

Exercise 4: Output tables (cont.)

- Look at MOVESOutput. Note all the cryptic (numeric) ID fields.
- Look at MOVESActivityoutput. Similar to MOVESOutput, but with distance values.
- MOVESRun contains information about the run (like run duration).
- MOVESError, MOVESWorkersUsed and MOVESEventLog tables are for run diagnostics.

Exercise 5: Post Processing - MySQL scripts

- Select “Post Processing” from top-level menu.
- Choose Run MySQL Script on Output Database.
 - DecodeMOVESOutput will add fields which describe the meaning for many of the numeric ID fields.
 - MPGCalculator will convert energy units and distance to miles per gallon.
 - TabbedOutput will export the contents of the output tables to ASCII tab delimited files.

Exercise 6: Post processing - Summary Report

- Select “Post Processing” from top-level menu.
- Choose Produce Summary Report.
- Choose the Process to report (or all).
 - Only the current output database is available.
 - Pollutants are reported separately.
 - All processes sums results by pollutant.

Exercise 6: Summary Report (cont.)

- Previous content of the report file is overwritten.
- Any run can be reported separately or in combination with other runs.
- Categories can be aggregated or reported separately and the order of sorting can be chosen.
- Results will be stored in a MySQL table.
 - Also display results on the screen.
 - Also write the results to ASCII text files.
- Three tables:
 - Header – description of the data sources for the report.
 - Body – results for fields chosen by the user.
 - Decode – description of categorical fields.

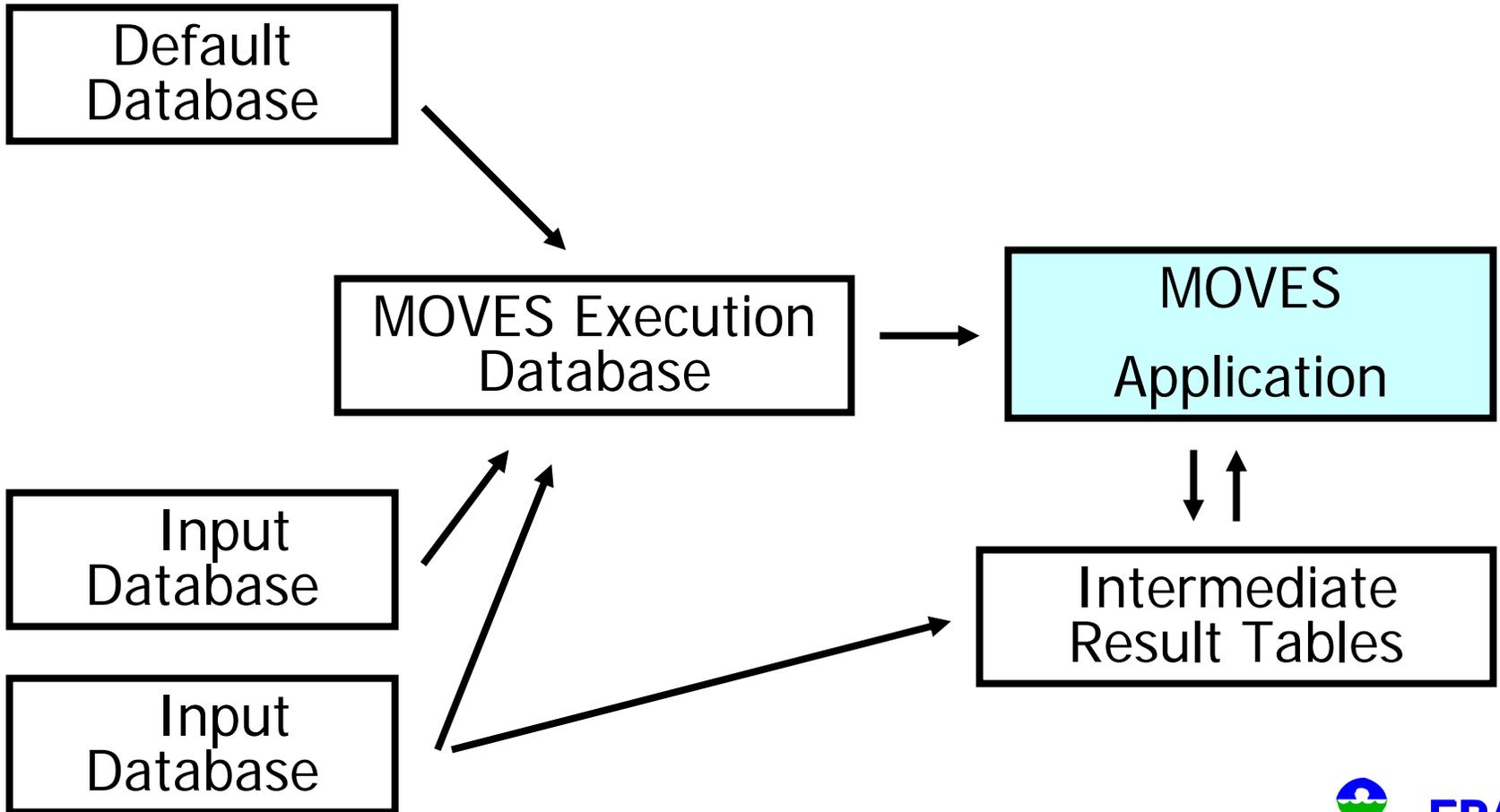
Exercise 7: Post processing – drawing maps.

- Select “Post Processing” from top-level menu.
- Choose Produce State/County Map
- Choose database table that contains result values.
- Identify field with State or County FIPS.
- Identify field with results to display. All results will be aggregated regardless of type.
- Refine display options.
- Map can be saved as standard JPEG.

User Input

- All factors needed to model all areas of the U.S. have default values. No additional information is required.
- ***All*** default values can be altered using either GUI pre-processors or by providing alternate tables of data.
- Users may also substitute values for intermediate results.

User Input - Databases



Exercise 8:

Create an input database

- Created using the MOVES GUI.
- Select - Manage Input Data Sets
 - Enter a database name – use MyInputs.
 - Use the Create Database... button.
 - All database tables will be empty.
- Input databases and tables can also be created manually using MySQL commands.

User Input – Pre-Processors

- Accessed from the pull-down menu.
- Allows users to create an input database with alternate input values directly from the MOVES GUI.
- Intended to be the primary way to include user supplied information.
- Has not been fully implemented.

Input Pre-Processor: Update Future Emission Rates

- Allows the user to create energy, CH₄ and N₂O emission rates for alternative fuel and advanced technology vehicles.
- Creates an EmissionRate table within the input database.
- Not likely of value to most non-EPA users.

Input Preprocessor: Edit I/M Coverage Records

- Displays the default descriptions of the I/M programs included in the run specification.
- Allows the user to change the description and save the results.
- Only needed to update default information.

Exercise 9:

Edit I/M Coverage Records

- Select Display/Edit I/M Program Coverage Records from the Pre-Processor menu.
- Select Generate New and Replacement Records, without selecting any records.
- Select an existing database or enter an input database name and select Create Database.

Exercise 9:

I/M Coverage (cont.)

- The I/M Coverage Categories screen can be used to add categories to the I/M program.
- Once categories are added they cannot be removed.
- Select at least one category from every section and choose OK.

Exercise 9:

I/M Coverage (cont.)

- The I/M Coverage Details screen allows you to select the coverage for any of the combination of categories you selected in the previous screen.
- The Adjustment Fraction reduces or increases the full benefits estimated for the base I/M program.

Other Input Options: Providing Alternate Input Data

- Importing using MySQL commands.
- Adding or editing data using the MySQL Query Browser (QB).
- Using other database applications to access MOVES MySQL tables.
- Data can be organized using any application.
- Data must be imported to MySQL tables for use by MOVES.

MOVES Input Database

- All input tables mimic default or execution tables.
- Tables are generally named in a way that suggests their primary key.
- Multiple input databases can be used simultaneously.
- Let's look.

Exercise 10:

Update age distributions

- a. Create an input database. (Done!)
- b. Create a text file with registration (age) information.
- c. Write a MySQL script to import the text file into the input database table.
- d. Run the MySQL script.

Exercise 10:

Create a text file to import

- Create a folder: C:\MOVES\Change
- Create an Excel spreadsheet (call it NewAgeDist.xls) in this folder.
- Put in the correct headings:
 - Use MySQL Query Browser to display the SourceTypeAgeDistribution table.
 - Put a field name at the top of each column.
- Find valid values for sourceTypeId.
 - Use MySQL Query Browser to display the SourceUseType table.
 - Choose the source type ID – select 21 (passenger car).
- Determine ranges for yearId and ageId.
 - Use MySQL Query Browser to display the AgeCategory table.
 - Use MySQL Query Browser to display the Year table. (Note that 1999 is a base year.) – use 1999.
- Enter 30 values which are each less than one and sum to one for each ageId.
- Save as comma-delimited (CSV) text.
- You could have created this text file with FoxPro, Access, Oracle, SAS, etc., etc.

Exercise 10:

Write a MySQL script

- In the Change directory, create a new text file, and name it LoadAge.sql
- This script will
 - add records if the primary key does not exist.
 - change records if the primary key does exist.
- This kind of script can work for every single table.

Exercise 10:

Write a MySQL script (cont.)

- In the script below, notice that
 - We use a complete path for the input file.
 - Forward slashes separate directories
 - The order of variables must exactly match the order in the text file. The heading line in the text file is ignored.
 - "#" indicates a comment

Exercise 10: Final MySQL Script (cont.)

```
# MySQL Script to alter SourceTypeAgeDistribution table.  
  
# Choose the input database to alter.  
use myinputs;  
  
load data  
infile 'c:/MOVES/Change/NewAgeDist.csv'  
replace  
into table SourceTypeAgeDistribution  
fields terminated by ','  
ignore 1 lines  
(sourceTypeId,yearId,ageId,ageFraction)  
;
```

Exercise 10: Run the script

- Open a command window
- Type

```
MySQL -vvv <
```

```
c:\MOVES\Change\loadage.sql
```

- The `-vvv` means verbose
- Note that you can now run any MySQL script!

Exercise 11:

Query the database

- We already did this sort of thing in Exercise 4
- Verify that our data got added:
 - Use the MySQL Query Browser or
 - `MySQL>select * from SourceTypeAgeDistribution where sourceTypeId=21 and yearId=1999;`

Exercise 12:

Export a table

- MySQL Query Browser
 - Use File/Export Resultset
 - CSV, HTML, XML, Excel and PLIST options.
- MySQL commands can also be used to export tables into text files.

```
select * into outfile  
'c:/MOVES/Changes/roadtype.txt'  
from roadtype;
```

Running MOVES from the Command line

- Allows multiple existing run specifications to be run consecutively unattended.
- Allows other computer programs to run MOVES.
- Described in the MOVES User Guide Appendix D.

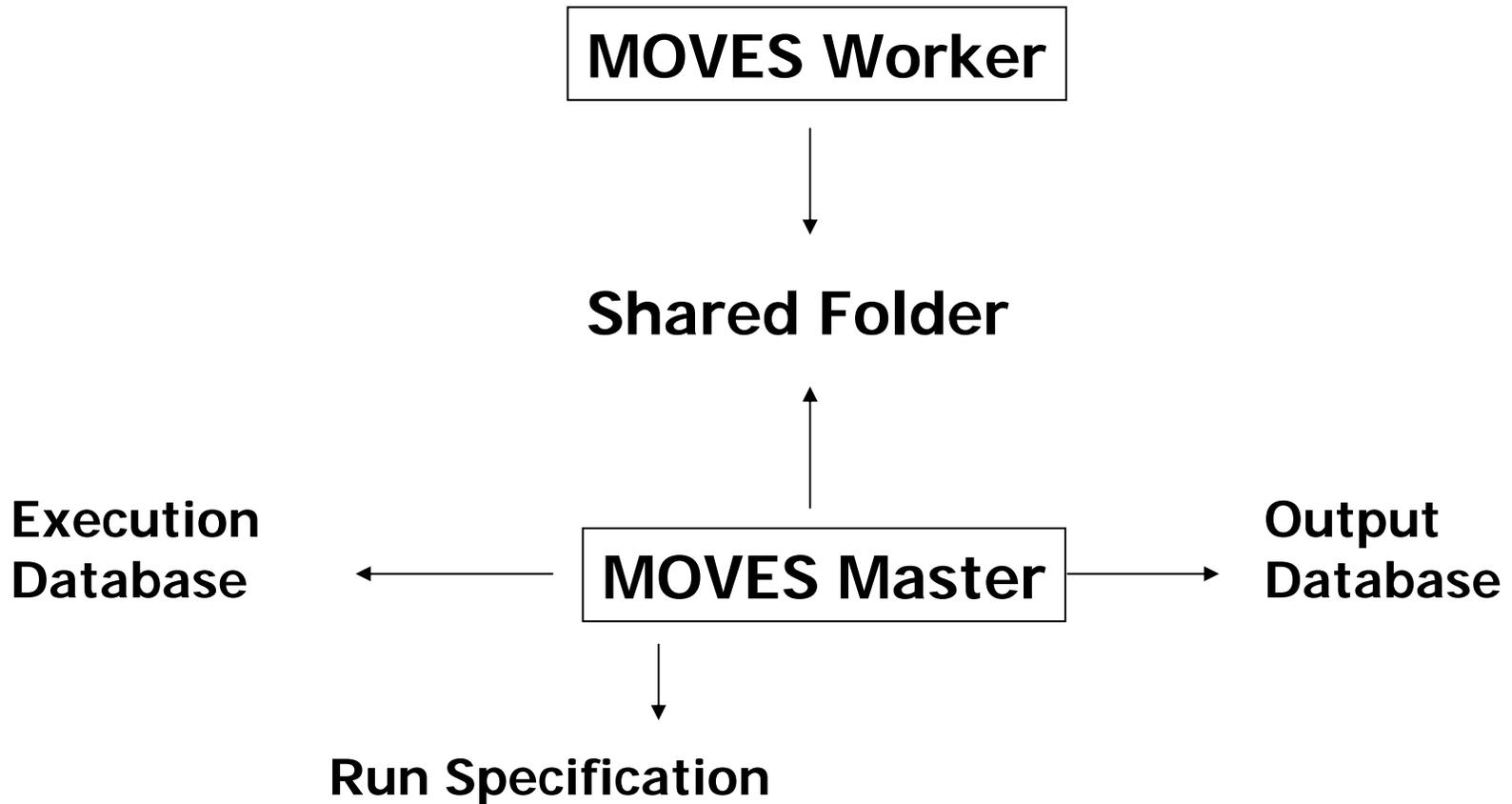
Run Specification Files: RunSpecs

- XML code that can be text-edited.
- Most codes are obvious or easy to figure out.
- Runspecs are best edited using the MOVES GUI to avoid problems.

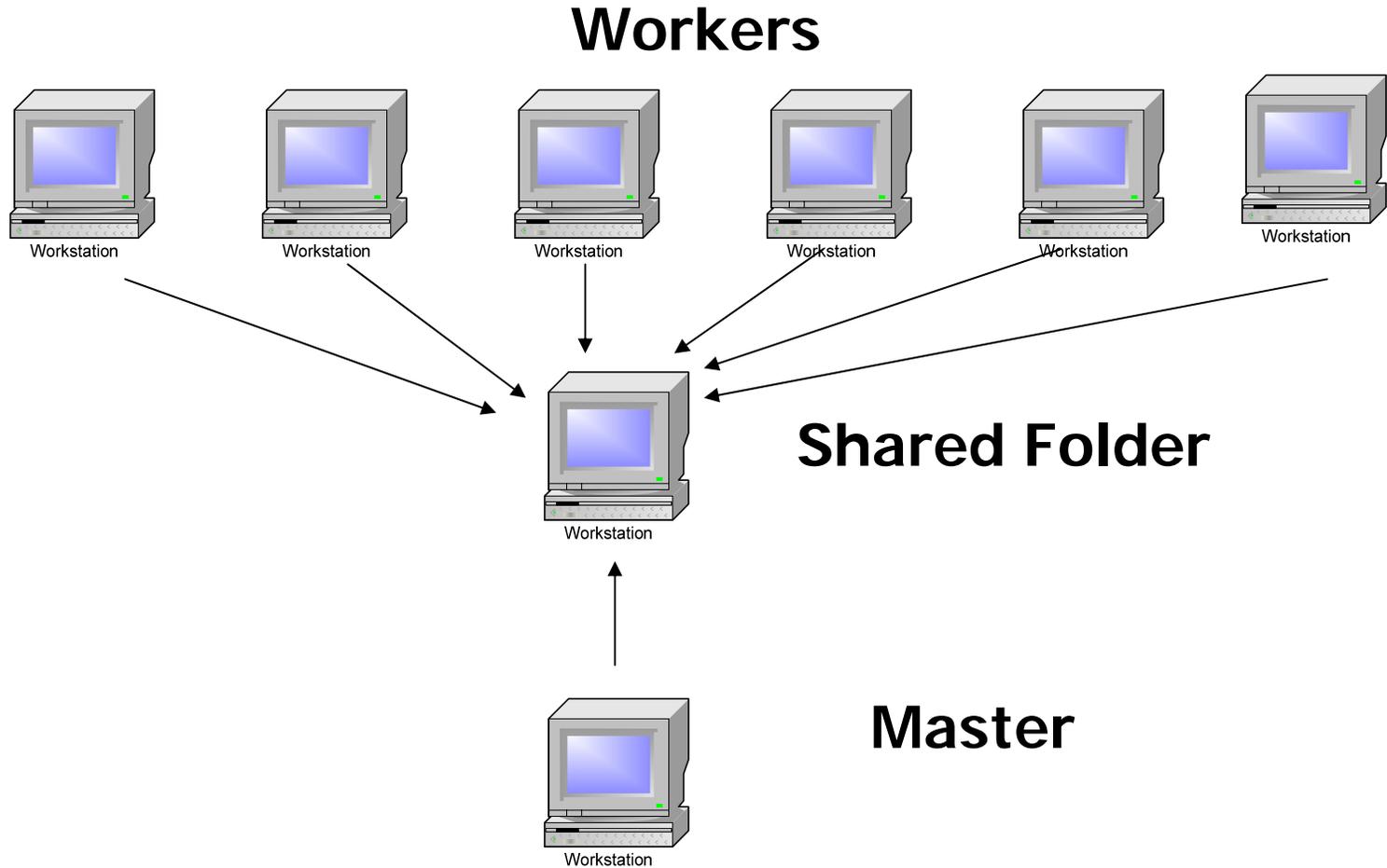
Exercise 13: XML RunSpec

- Look at test1.mrs using a text editor
- Look at it using the MOVES GUI
- Extra
 - Change it using the text editor.
 - Look at the change in the MOVES GUI.
 - Change it using the GUI.
 - Look at the change using the text editor.

Standalone Processing



Distributed Processing



Distributed Processing

- Workers and Master must point to the same shared folder
- Run only one worker per machine (their temporary database tables will interfere with each other)
- If you have distributed workers, there is no point in running a worker on the Master machine.

Gotchas

- Limit your run specification to just what you need.
- Don't mix up which databases contain input and output data.
- Organize your inputs and outputs so you don't get confused.

Concepts

- Don't mix up databases and tables.
 - Databases are collections of tables.
 - The tables contain the information.
- Don't alter the EPA default database.
 - All new information you want to use can be included in an input database.
 - Changing the defaults, without changing the database name, will cause confusion.
 - You can create your own default database.

Concepts (cont.)

- Aggregation of input reduces run time, but is not the same as aggregation of output.
- Many inputs are “domain wide”, limit each RunSpec to a single domain.
- Not all calendar years are base years. Non-base years are projected.

Concepts (cont.)

- Time is generic. You need to enter data to get a specific time.
- The “off network” road type is a catch-all for any highway vehicle emissions that are not directly associated with specific roads on the network roadways.
- Your own data may be able to be used in intermediate tables directly.

Microsoft Access Database Program Can Be Used as As a Front End for MySQL

- Get ODBC Driver - free download from MySQL.com
 - MyODBC-standard-3.51.07-win.exe
 - Install by clicking on it
- Set up ODBC connection for your MySQL DB
 - Start, settings, control panel, administrative tools,
 - data sources, System DSN tab
 - Add
 - Choose Driver (MySQL ODBC 3.51 Driver), Finish
 - Data Source Name and Database Name: County20040508
 - OK

Microsoft Access (cont.)

- Open Access
- File, new, blank database
- Create where you want it
- File, get external data, link tables
- Files of type: "ODBC databases"
- Machine databases tab
- Select database name, OK
- Link Tables, Select all, OK

There are Three MOVES Configuration Files

- Initial configuration is done during installation.
- MOVESConfiguration.txt
 - Default MOVES database.
 - Path to SharedWork folder.
- WorkerConfiguration.txt
 - Path to SharedWork folder.
- Setenv.bat
 - Paths to Java & its libraries.

MOVESConfiguration.txt

- Must point to a valid MOVES default database.
- Shared folder must already exist.
- Identifies location of GREET application.
- Use “localhost” for the server names.
- ComputerID helps identify results.

WorkerConfiguration.txt

- Shared folder must already exist.
- Worker will only do work that is placed in the shared folder, so this folder must match the shared folder used by a Master.
- ComputerID helps identify results and locate problems when there are multiple workers.

Exercise 14:

Examine MOVE Configuration

- Open the MOVESConfiguration.txt file.
 - What is the default database?
 - Where is the shared folder?
 - What is the master name?
- Open the WorkerConfiguration.txt file.
 - Where is the shared folder?
 - Is it the same as the MOVES master?
 - What is the worker name?

Appendix A: Uninstalling MySQL

- When you update MySQL it is sometimes safer to uninstall your current version.
- Step 1: Back up your data.
 - Copy the contents of the MySQL\Data folder to a backup location.
 - Copy any runspecs or other user created files to a backup location.

Appendix A: Uninstalling MySQL (cont.)

- Step 2: Stop MySQL.
 - Open a DOS command line prompt window.
Use the following commands:
 - C:\
 - CD \
 - Net stop MySQL
 - C:\mysql\bin\mysqld-max-nt.exe –remove MySQL

Appendix A: Uninstalling MySQL (cont.)

- Step 3: Uninstall MySQL from Windows.
 - Under Windows Start go to Settings/Control panel.
 - Run the Add or Remove Programs.
 - Find and Select MySQL Servers and Clients.
 - Click the Change/Remove button.
 - Remove MySQL.