AIMMS PRO:
Client Server Architecture & Distributed Computing

Peter Nieuwesteeg
Senior AIMMS & Optimization Specialist
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Roadmap

- AIMMS
- AIMMS PRO
- Case Study: Portfolio Optimization
AIMMS’ purpose and mission

Bring the **benefits of optimization technology** to society

To **enable** people to apply optimization technology **successfully** into their organizations
AIMMS Overview

**Easy**

**Fast**

**All in one**

**SETUP AIMMS**

**GUI CONSTRUCTION**

**MODEL BUILDING**

**SOLVERS**

**AIMMS Productivity Tools**
- Page Manager
- Template Manager
- Menu Builder

**Model Explorer**
- Identifier Selector
- Data Manager
- Data Management Setup

**Solvers**
- CPLEX
- GUROBI
- XA
- CONOPT
- CBC
- PATH
- SNOPT
- MINOS
- KNITRO
- IPOPT
- MOSEK
- BARON
- LGO
- AOA
- AOA (+OSI)

**External DLLs**
- Fortran/C/C++

**Databases**
- ODBC/OLE DB
- XML / Excel

**SDK** (Java, .NET)

**AIMMS PRO**

www.aimms.com
Challenges to apply optimization successfully?

- Easy access to various optimization models;
- Ability to gain insight in results:
  - Visualization of results;
  - What if analysis;
- Access to appropriate hardware and software.
Client Server Architecture made easy

AIMMS PRO
What is AIMMS PRO?

AIMMS Publishing and Remote Optimization Platform

A deployment platform to offer and manage
AIMMS-based optimization solutions in a simple and efficient manner

.. an appStore for optimization-based apps
Offers business users:

1. Access to various models,
2. The ability to open the latest version directly from the browser,
3. Solve the Optimization Model on a (powerful) remote server,
4. Retrieve model results from server,
5. Change the data and rerun the model,
6. Visualize the results in a GUI;
Why AIMMS PRO?

**Publishing**
- Reduce effort and technical hurdles to issue new or updated applications to a bare minimum
- Create uniformity
  - Assure homogeneous application use throughout organization
  - Assure match application and AIMMS version

  ➔ *Add instant value to the business by making the models easily accessible*

**Remote Optimization**
- Share and manage resources (hardware, software, licenses)
- Move heavy execution from local machines to central servers

  ➔ *Leverage technology & resources in an efficient way*
PRO Framework Setup

AIMMS PRO SERVER

AIMMS Run-Time Models

AIMMS Clients

Monitoring GUI

Client

Server
Using PRO
Basic Steps End User

✓ End User perspective:
  - *Open* PRO Application Portal
  - *Run* AIMMS App by clicking icon
  - Watch your jobs in the portal
  - Open finished jobs within AIMMS App
  - View statistics of AIMMS App use
Using PRO
Basic Steps Developer

End User perspective:
- Open PRO Application Portal (web page)
- Run application by clicking icon

Developer perspective:
- Add call `pro::DelegateToServer()` at start of procedure to run it remotely
- Link Request Management page
- Publish AimmsPack
Using PRO
Basic Steps IT

✓ Administrative perspective:
  – Setup preferred server or cloud & Install PRO Server
  – Publish AIMMS Versions & Activate AIMMS Licenses
  – Monitor & Manage all Apps, AIMMS versions, and Users
  – View Statistics on use of PRO Platform
CASE STUDY: PORTFOLIO OPTIMIZATION

Using AIMMS PRO for distributed computing
Investment portfolio

• The user wants support in deciding how to invest the capital budget to maximize the long term profit, considering:
  – Various investment opportunities;
  – Flexibility in start date of investments;
  – Multi year planning interval;
  – Budget restrictions;
  – Operational restrictions;
  – Net Present Value (NPV).
Uncertainty

• The constructed model is a large (deterministic) MIP, but in the real world there is uncertainty in:
  – Commodity pricing;
  – Capital expense;
  – Operating expense;
  – NPV discount factor.

• The user would like to see various possible investment strategy and the impact of the uncertainty;
Single Computer Process

Solve MIP model (with solution pool)

Retrieve Integer Solution from pool

Sample uncertain data and solve LP model

Store NPV data

Finished
Distributed Computing Process

Solve MIP model (with solution pool)

- Retrieve Integer Solution from pool
  - Sample uncertain data and solve LP model
  - Store NPV data

Session 1

... (multiple sessions)

- Retrieve Integer Solution from pool
  - Sample uncertain data and solve LP model
  - Store NPV data

Session N

Finished
Complete Procedure

PROC_OptimizeScenarioCombinations

PRO::ManagedSessionOutputCaseIdentifierSet := 'AllIdentifiers';
PROC_OptimizeMasterModel;

PRO::ManagedSessionOutputCaseIdentifierSet := PRO_SimulationOutput;

for ( sc | ord(sc) <= NumberofSolutions) do

    Selected_Scenario := sc;

    PROC_MonteCarloSimulationPRO(Selected_Scenario) ;

EndFor ;
Solving the Master Optimization Model

```plaintext
if pro::DelegateToServer('PROC_OptimizeMasterModel',
    requestDescription: RequestName_MM,
    waitForCompletion : 1,
    completionCallback : 'PROC::session::LoadResultsCallback')
then
    return 1;
endif;

option do_populate := "Yes";

GMP:Instance::Generate(PortfolioOptimizationModel, "GMPPortfolioOptimization");
GMP:Instance::Solve(GMPPortfolioOptimization);
NumberOfSolutions := GMP:Solution::Count(GMPPortfolioOptimization);

option do_populate := "No";

CaseFileSave("PRO:\PublicData\Cases\Portfolio_Optimization\MasterSolution.data", AllIdentifiers);
```

Comment
Perform Monte Carlo Simulation
Send progress information

```plaintext
if not mod(Loopcount,100) then
    PROC_MonteCarloProgress(Selected_Scenario, ProgressCounter)
endif;
```

```plaintext
PROC_MonteCarloProgress

Procedure: PROC_MonteCarloProgress
Arguments: (SessionID, PercentageCompleted)

Body:
if pro::DelegateToClient(
    procedureName : 'PROC_MonteCarloProgress',
    flags : 0)
    then return 1; endif;

SimulationCompleted(SessionID) := PercentageCompleted;
```
USER EXPERIENCE
Login on the PRO Framework

Optimize anywhere!

With AIMMS PRO, you can launch AIMMS applications right from your browser if you are on a Windows machine. Log on to see which applications are available to you.

Environment
Customer Demo

Username
Peter

Password
******

Login

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Overview of apps
Portfolio Optimization

Efficient Frontier

Frequency View

Mean NPV is between 3,127 MM$ and 3,154 MM$ with 95% confidence
## PRO Framework - User Requests

View requests since: 

- Show requests from all users

<table>
<thead>
<tr>
<th>Selected Request</th>
<th>Time</th>
<th>Status</th>
<th>Results?</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario-20 of case Global Data</td>
<td>2014-03-08 20:14:59</td>
<td>Queued</td>
<td></td>
<td></td>
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<tr>
<td>Scenario-17 of case Global Data</td>
<td>2014-03-09 20:14:58</td>
<td>Queued</td>
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<tr>
<td>Scenario-13 of case Global Data</td>
<td>2014-03-08 20:14:55</td>
<td>Queued</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario-19 of case Global Data</td>
<td>2014-03-09 20:14:58</td>
<td>Queued</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario-15 of case Global Data</td>
<td>2014-03-09 20:14:57</td>
<td>Running</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario-16 of case Global Data</td>
<td>2014-03-09 20:14:57</td>
<td>Running</td>
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<td>Scenario-11 of case Global Data</td>
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<td>Finished</td>
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<td>Finished</td>
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<td>Scenario-13 of case Global Data</td>
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<td>Running</td>
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<td>Scenario-14 of case Global Data</td>
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<td>Scenario-07 of case Global Data</td>
<td>2014-03-08 20:14:54</td>
<td>Finished</td>
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</tbody>
</table>
Summary

• High level overview of AIMMS for fast, easy application development;
• AIMMS PRO for easy deploying of model in client server architecture;
• AIMMS PRO for using model in distributed environment.
Thank you!

Or email me at Peter.Nieuwesteeg@aimms.com

For more information:

– www.aimms.com
– www.aimms.com/trial