WVU WCRL Communication Theory Cloud: An Introduction

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April 3rd, 2013

Outline

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Project Goals

The goal of the WCRL Communication Theory Cloud (WCTC) is to provide researchers in communication theory access to high-performance computing resources for simulation of communication systems.

Features

- Implement simulation logic using the WCRL Coded Modulation Library (CML).
- Utilize a 384-core computing cluster for computational power.
- Accessible to researchers through a web interface.

Coded Modulation Library

Introduction

- Library of communication system simulations developed at WVU.
- Implemented using MATLAB and C-mex.
- Free software (licensed under lesser GPL)
- Download from `http://code.google.com/p/iscml/wiki/cml`

Brief list of features

- Modulation: PSK, QAM, APSK, CPM (CPFSK)
- Channel Coding: convolutional, turbo, BTC, LDPC, Hybrid-ARQ
- Information theoretic bounds (channel capacity; outage probability)
- TWRC physical-layer network coding: noncoherent FSK relay receiver

WCRL Computing Cluster

- Located on WVU Engineering Campus.
- 21 rack-mounted servers.
- Processing cores per server: 8, 16 or 32.
- Total processing cores: **384**.
- Hosts WCTC web interface and simulation logic.
- Performance stats available at `http://wcrlcluster.csee.wvu.edu/ganglia`

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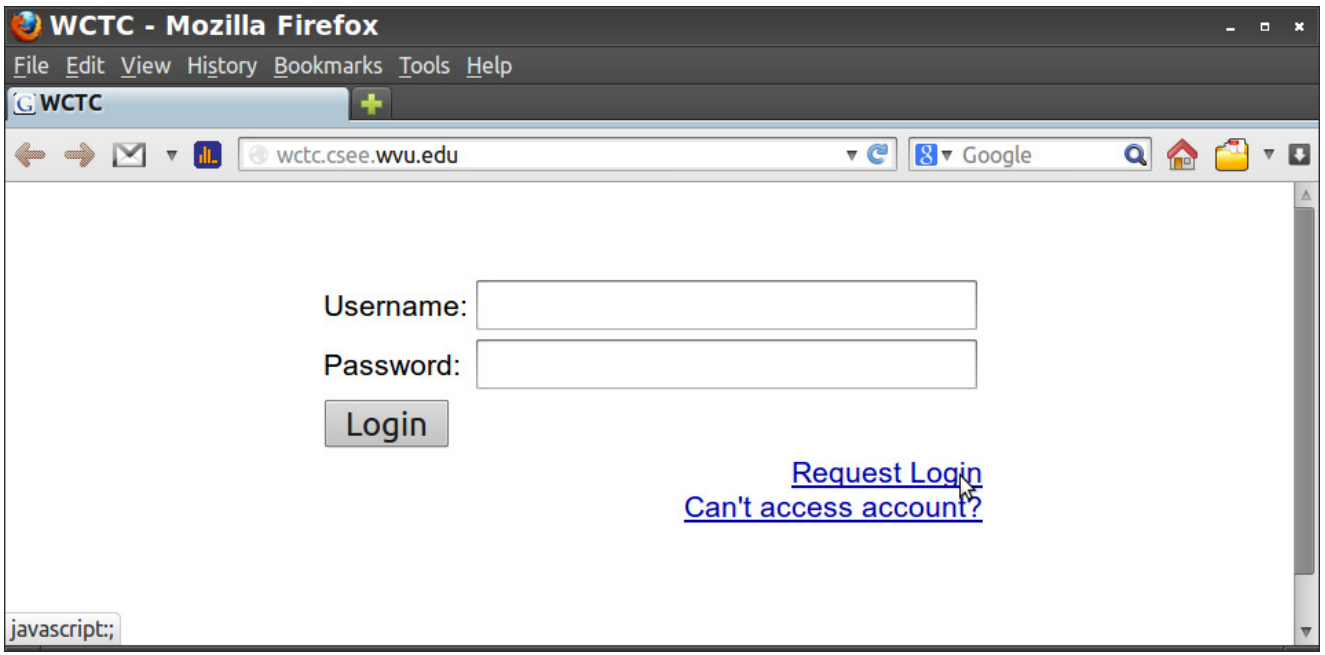
Creating a WCTC Web Interface Account

- An account is required to access the WCTC web interface.
- To create an account, access `http://wctc.csee.wvu.edu` and follow the link "Request Login".



  - You will receive an e-mail containing your username and password.
- Your WCTC account allows you to submit CML error-rate jobs for execution and download results.

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Introduction

- The purpose of this tutorial is to introduce the user to submitting jobs to the WCTC web interface.
- A CML error-rate simulation of BPSK modulation in an AWGN channel is submitted as a WCTC job.
- The job results are saved to the user's local machine and plotted using CML.

Assumptions

In this tutorial, it is assumed that the user has

- A working MATLAB version $\geq$ 7.6 (R2008a)
- Downloaded the WCRL Coded Modulation Library (CML) from `http://code.google.com/p/iscml/wiki/cml`.
- Installed CML into local directory <CMLROOT>.
- Followed the quickstart tutorial on the download site to familiarize with fundamental CML concepts.
- Created a WCTC Web Interface Account as described in Section 3.

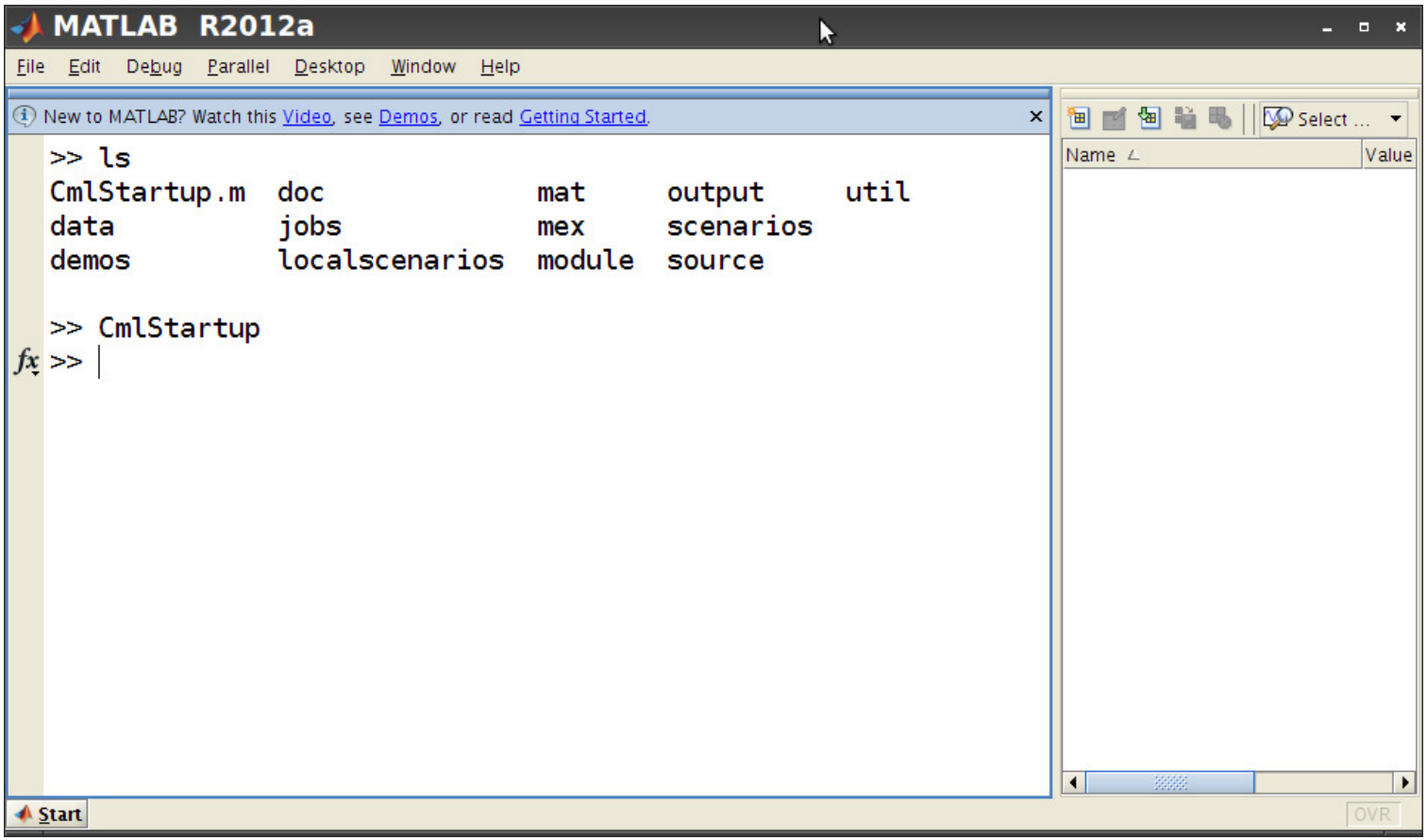
Terminology

The following terminology will be used throughout the tutorial:

- Local computer - The user's computer running CML.
- <CMLROOT> - Directory on user's local computer containing CML.
- Cluster - The server infrastructure administered by WCRL which hosts WCTC.
- Job File - File generated by CML which contains the parameters of a single simulation for submission to using the WCTC web interface.

Starting CML

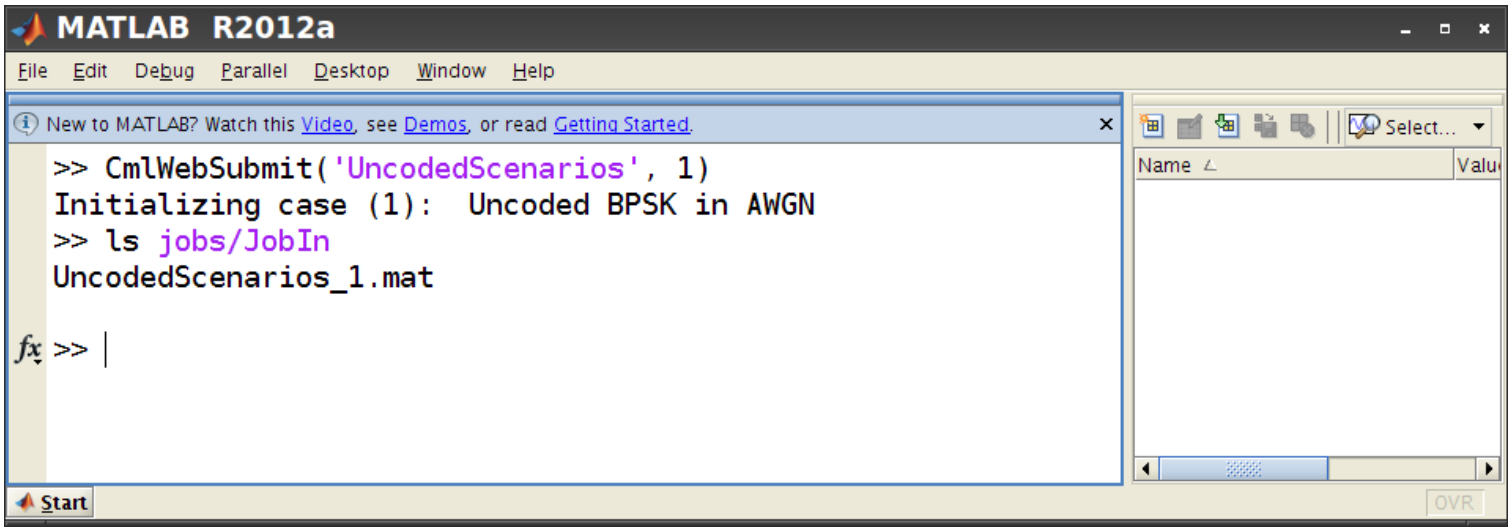
- Start MATLAB and cd to <CMLROOT>.
- Execute function CmlStartup() to initialize CML.



Creating a Job File

In this example, we create a job file for an error-rate simulation of uncoded BPSK in AWGN.

- Scenario: UncodedScenarios
- Record: 1

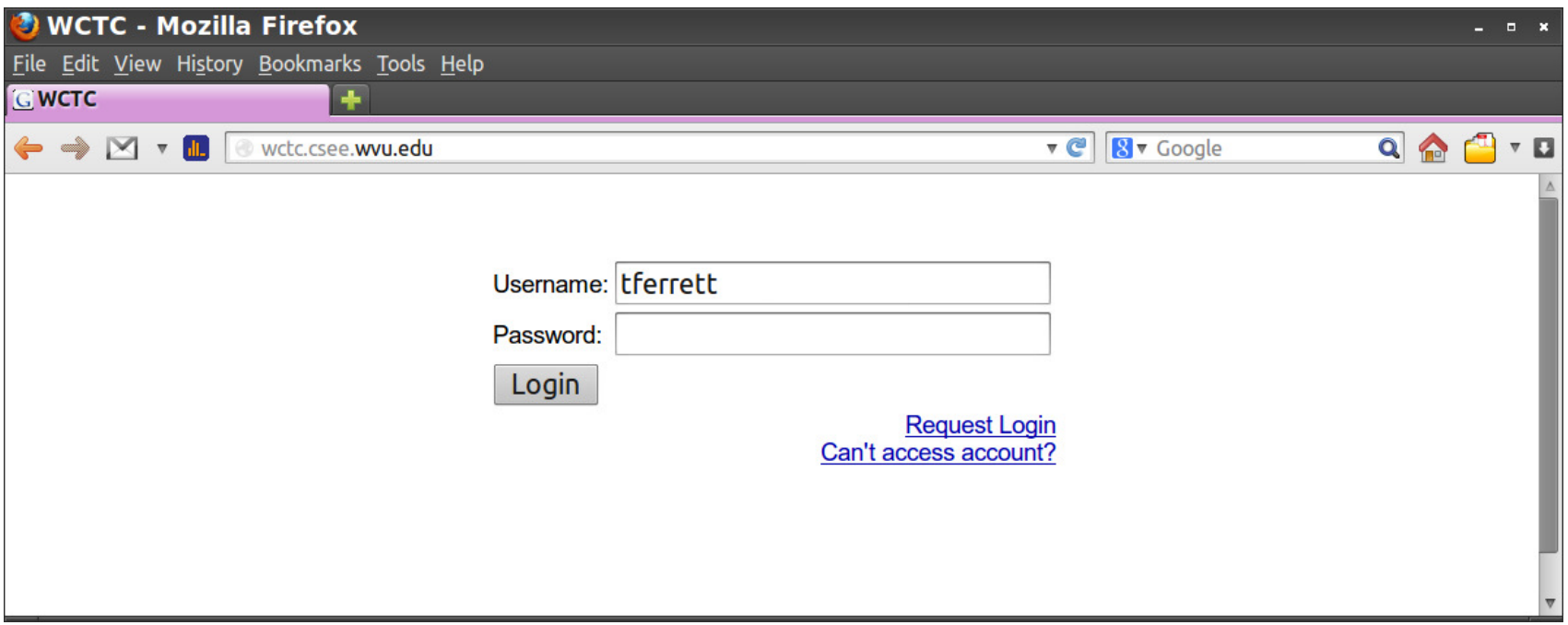


- CmlWebSubmit() has created the job file <CMLROOT>/jobs/JobIn/UncodedScenarios_1.mat

WCTC Web Interface Login

- To submit the generated job file, log in to the WCTC web interface located at
  `http://wctc.csee.wvu.edu`

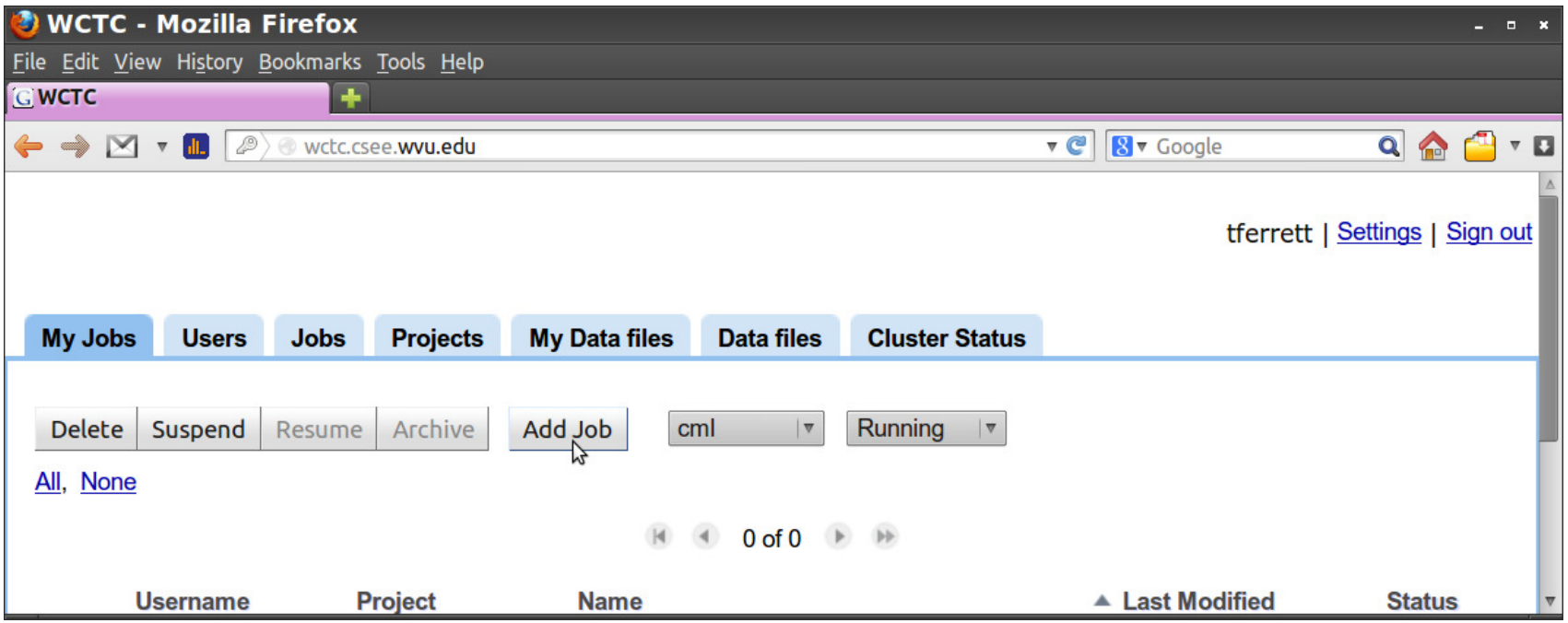
- Use the credentials created in Section 2.



Job File Submission

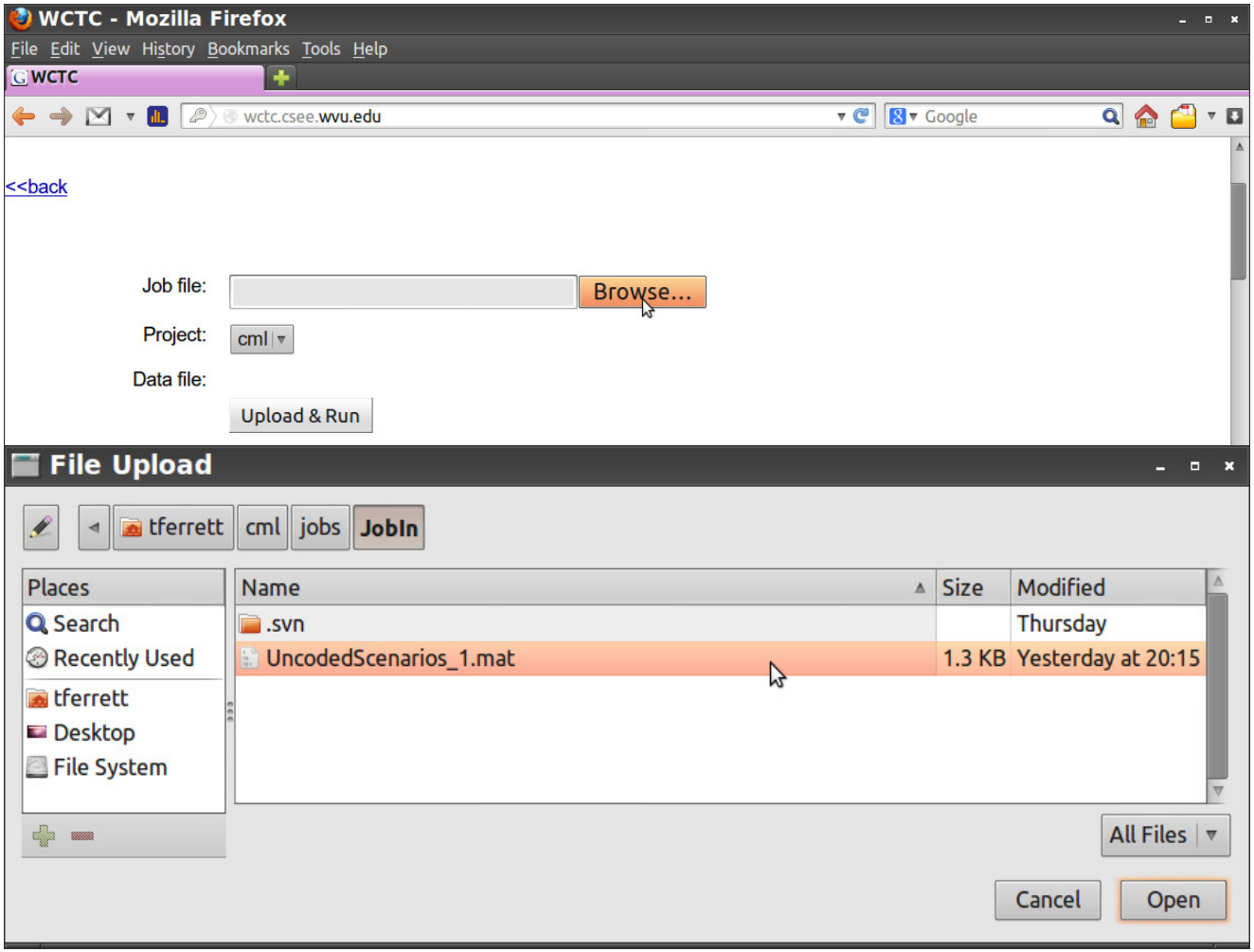
In this step we will add the job file to the input queue for execution.

- Click the tab "My Jobs", bringing up the job manipulation interface.
- In the drop-down next to the button "Add Job", select project "cml".
- Click the button "Add Job" as shown in the figure.



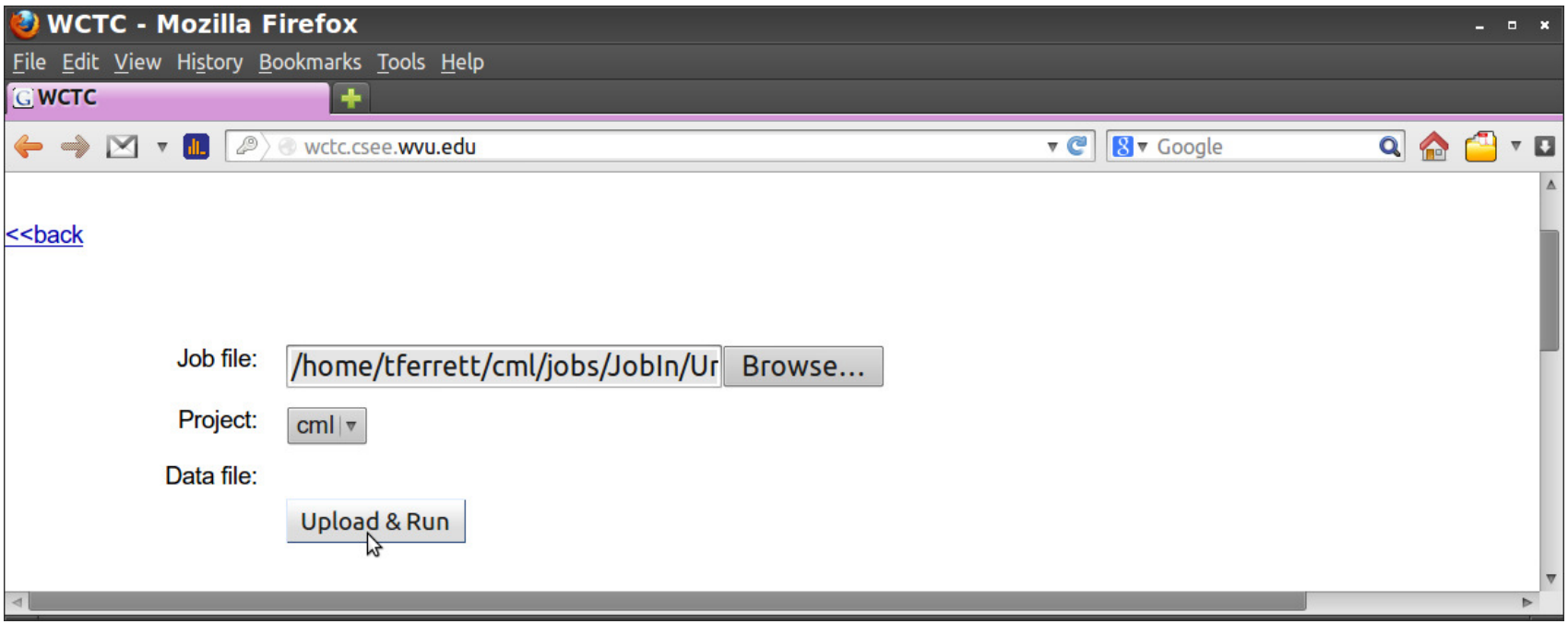
Select the job file to upload from the local filesystem.

- Click the "Browse" button. This will open a file selection dialog.
- Select the job file <CMLROOT>/jobs/JobIn/UncodedScenarios_1.mat



Uploading and running the job file submits the job to the cluster input queue for execution.

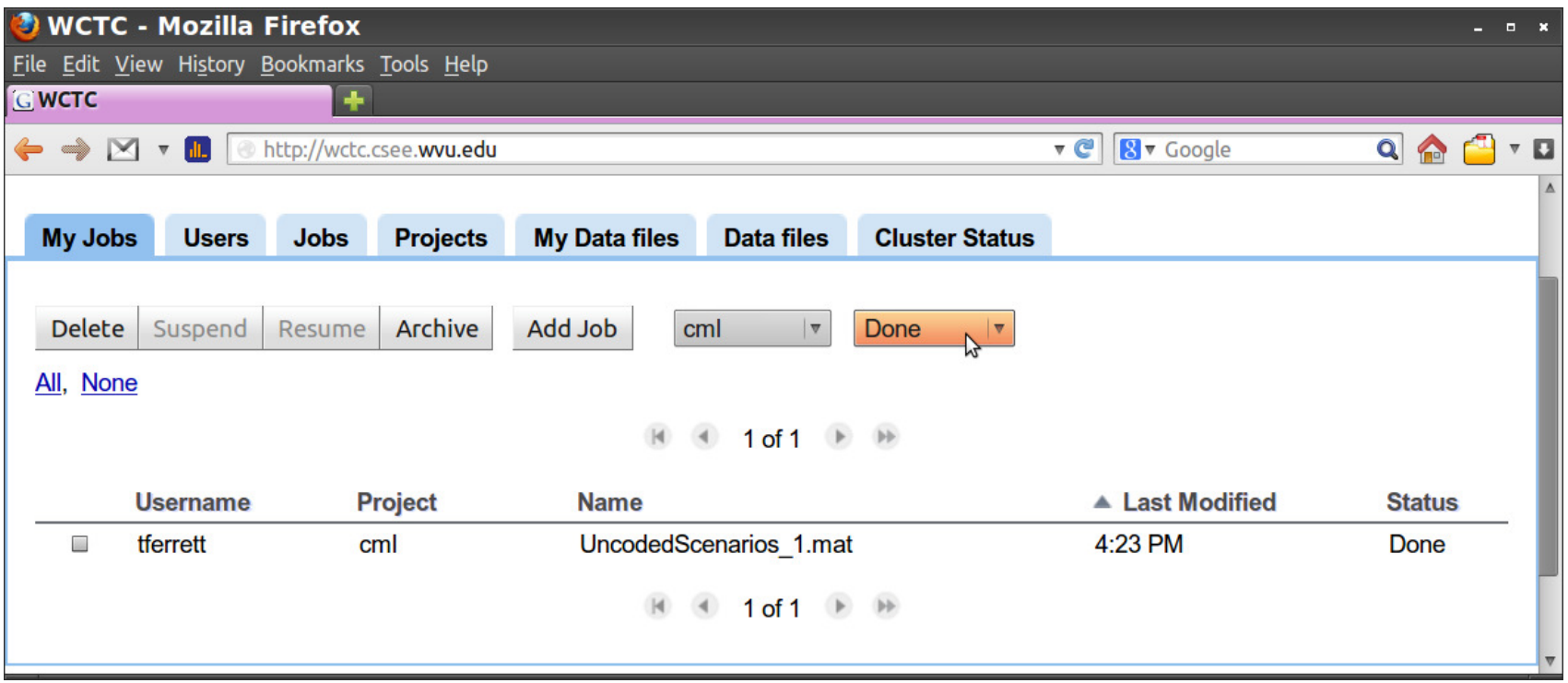
- Click "Upload & Run" to submit the job to the input queue.



Job Execution

The job is now executed on the cluster when resources are available.
To check for job completion,

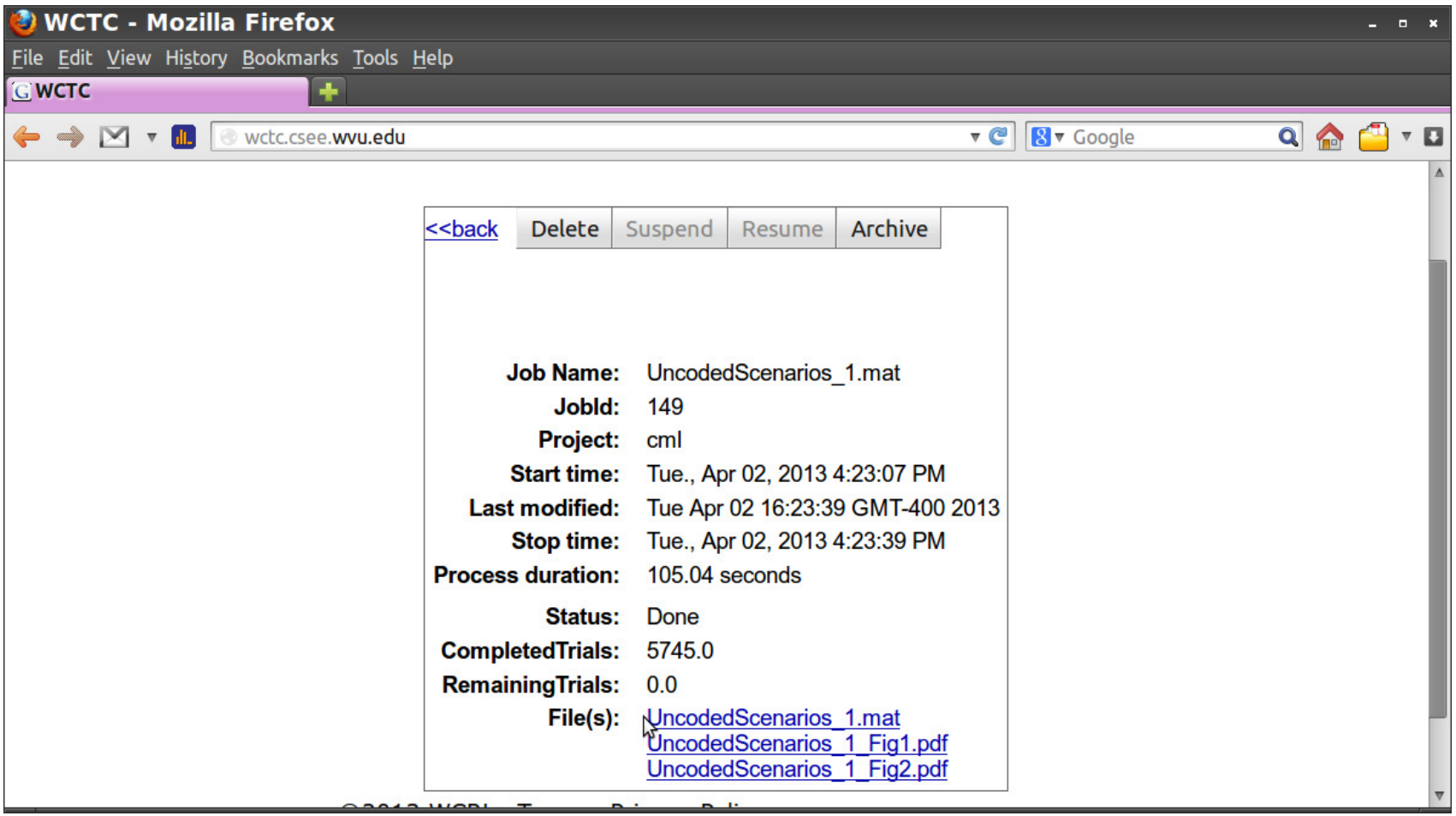
- In the drop-down menu highlighted in the figure, select "Done".
- The completed job will appear in the table at the bottom of the page, as shown in the figure.



Job Results Retrieval

Now that the job is complete, retrieve the results for local plotting.

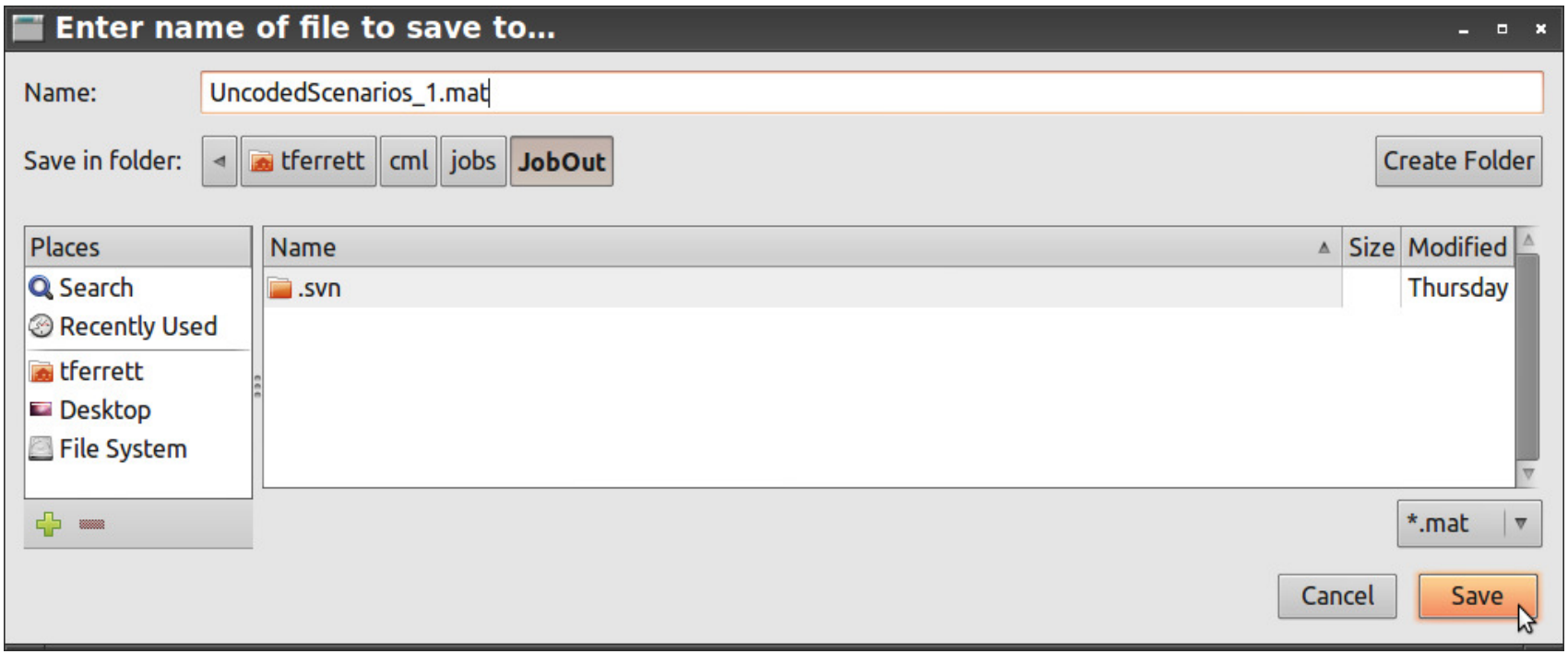
- Click the link to the name of the job file as shown in the figure and perform a "Save As" operation.



- All completed jobs must be placed in <CMLROOT>/jobs/JobOut for processing by CML.

- When prompted for a location to save the completed job file, specify
  - <CMLROOT>/jobs/JobOut/UncodedScenarios_1.mat

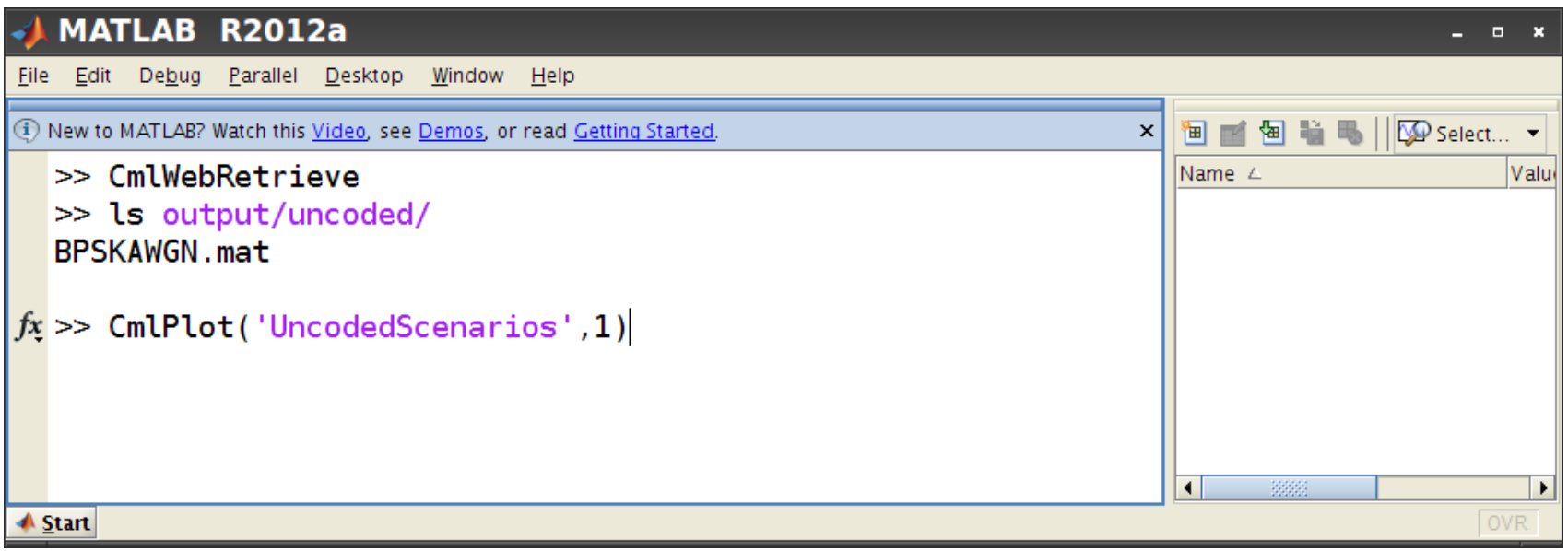
  as shown in the figure.

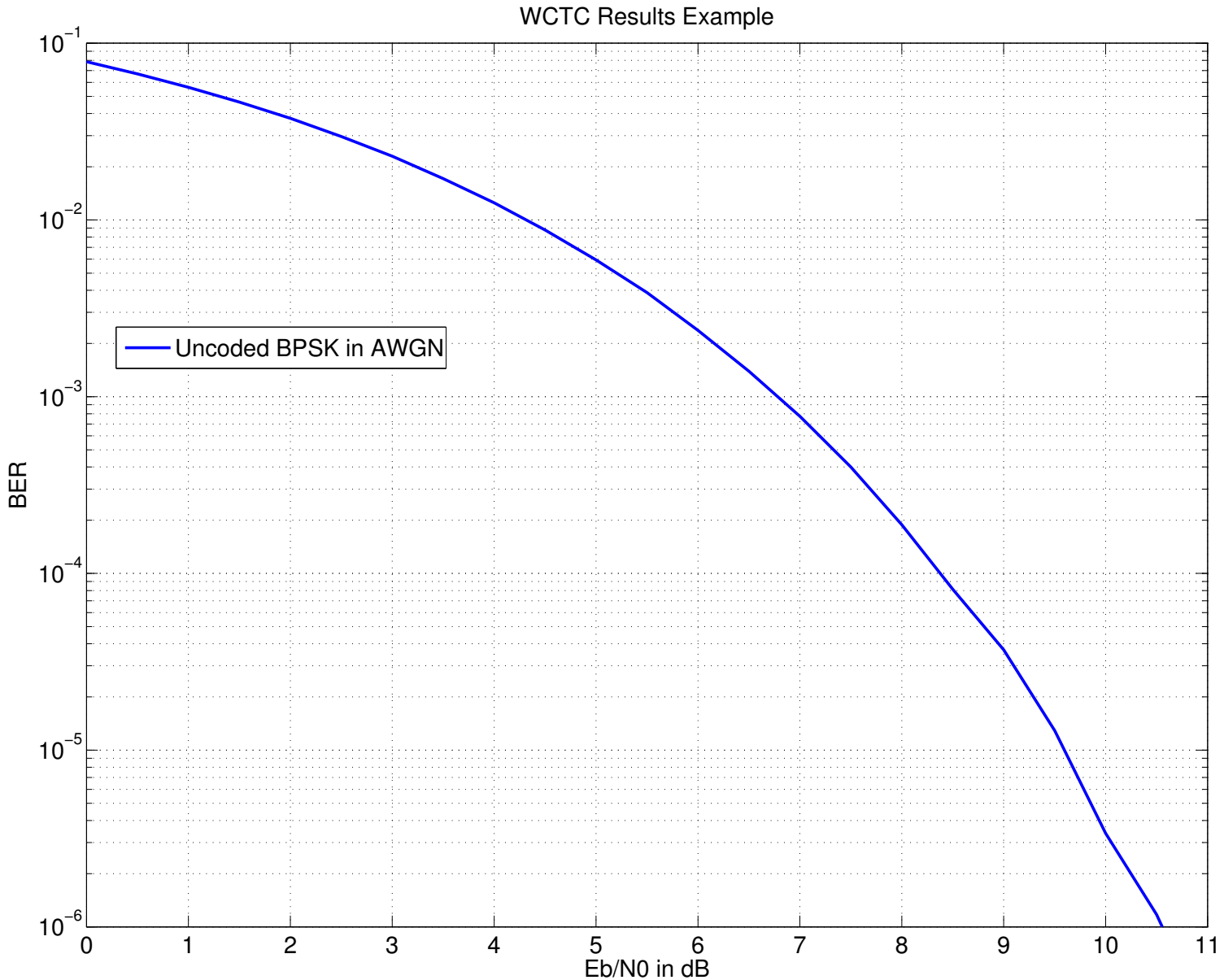


Job File Conversion and Result Plotting

The completed job file must be converted to a CML output file appropriate for plotting.

- Execute the function 'CmlWebRetrieve' to convert the job file to a CML output file as shown in the figure.
- The results of simulation may now be plotted as shown.




WCTC Results Example
BER
Eb/N0 in dB
Uncoded BPSK in AWGN
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
0
1
2
3
4
5
6
7
8
9
10
11

Outline

Steps to Submitting a Job

1. Create a WCTC account at `http://wctc.csee.wvu.edu`
2. Download and install CML from `http://code.google.com/p/iscml/wiki/cml`
3. Select a CML error-rate scenario and record to simulate and create a job file using
   >> CmlWebSubmit(scenario, record)

   The job file is located in
   <CMLROOT>/jobs/JobIn/<scenario>_<record>.mat
4. Log in to the WCTC web interface and upload the job file.
5. Once the job is completed, download the job results file to
   <CMLROOT>/jobs/JobOut/<scenario>_<record>.mat
6. Convert the job results file to a CML output file and plot
   >> CmlWebRetrieve
   >> CmlPlot(scenario, record)