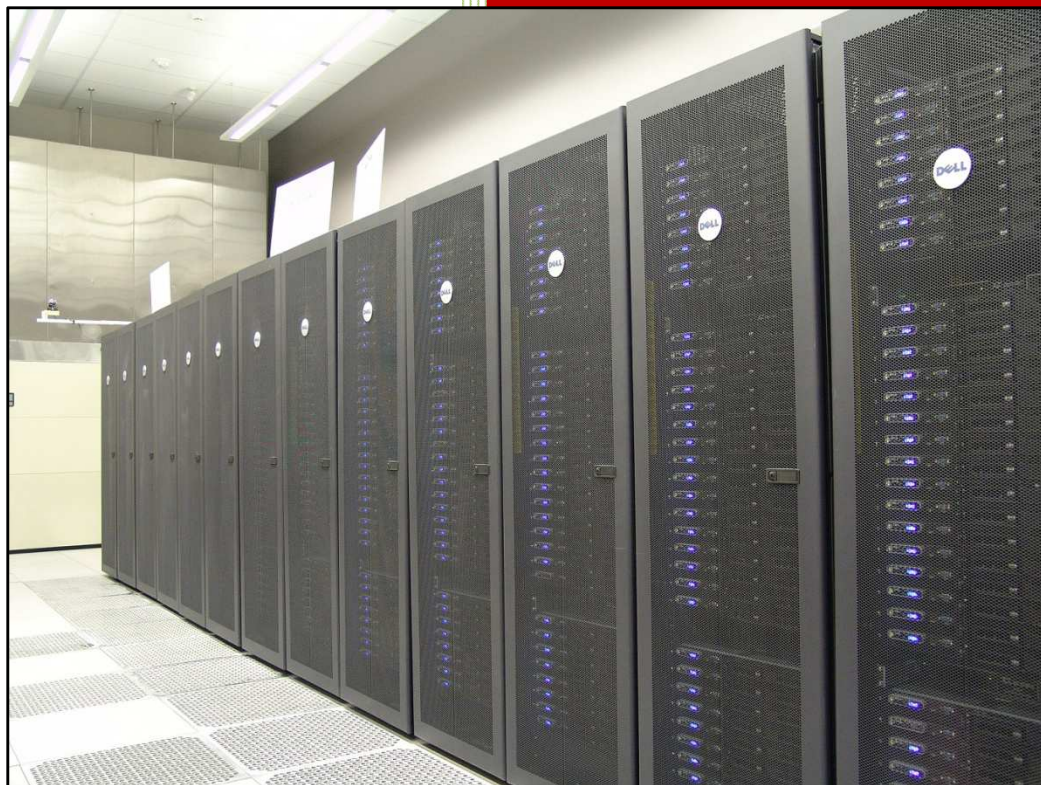


HPCC - Hrothgar

Getting Started User Guide – Cplex



High Performance Computing Center
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User Guide

1. Introduction

ILOG CPLEX's mathematical optimization technology enables better decision-making for efficient resource utilization. With ILOG CPLEX, complex business problems can be represented as mathematical programming models. Advanced optimization algorithms allow you to rapidly find solutions to these models.

2. Setting up the environment

Hrothgar is equipped with SoftEnv to set up the environment with minimum work by users. The use of SoftEnv is not required but highly recommended by HPCC staff.

Step 1: setting up user environment

If the user environment is already set up, please skip this step.

At the first use, the user should copy two sample dot-files: dot-bashrc is the start up script which evokes SoftEnv; dot-soft contains a list of software whose specific environment variables will be set up for the user.

```
$ cp /lustre/work/apps/examples/dot-bashrc .bashrc  
$ cp /lustre/work/apps/examples/dot-soft .soft  
$ ln -s .bashrc .bash_profile
```

Log out and log in again.

The screenshot shows an SSH terminal window titled "1:grendel.hpcc.ttu.edu - default - SSH Secure Shell". The terminal displays the following commands and output:

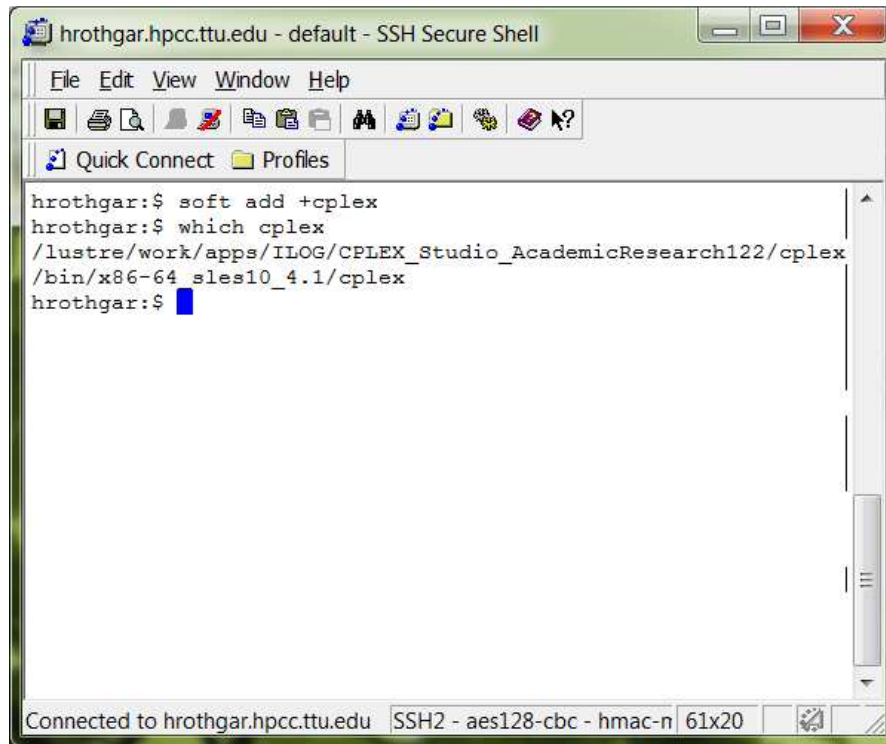
```
-bash-3.2$ pwd
/home/pmane
-bash-3.2$ ls -al
total 60
drwxr-xr-x  4 pmane CS   4096 Jul 13 13:36 .
drwxr-xr-x 430 root  root 12288 Jul 12 08:35 ..
-rw-----  1 pmane CS  15117 Jul 13 12:16 .bash_history
drwxr-xr-x 12 root  root  4096 Jul 13 11:47 examples
-rw-----  1 pmane CS   1675 Jul  2 2009 pmane_id
-rw-r--r--  1 pmane CS    408 Jul  2 2009 pmane_id.pub
drwx-----  2 pmane CS   4096 Jul  6 2009 .ssh
-rw-----  1 pmane CS   5783 Jun  8 16:49 .viminfo
-rw-----  1 pmane CS    192 May  5 20:15 .Xauthority
-bash-3.2$ cp /lustre/work/apps/examples/dot-soft .soft
-bash-3.2$ cp /lustre/work/apps/examples/dot-bashrc .bashrc
-bash-3.2$ ln -s .bashrc .bash_profile
-bash-3.2$ ls -al
total 64
drwxr-xr-x  4 pmane CS   4096 Jul 13 13:45 .
drwxr-xr-x 430 root  root 12288 Jul 12 08:35 ..
-rw-----  1 pmane CS  15117 Jul 13 12:16 .bash_history
lrwxrwxrwx  1 pmane CS      7 Jul 13 13:45 .bash_profile -> .bashrc
-rwxr-xr-x  1 pmane CS    522 Jul 13 13:44 .bashrc
drwxr-xr-x 12 root  root  4096 Jul 13 11:47 examples
-rw-----  1 pmane CS   1675 Jul  2 2009 pmane_id
-rw-r--r--  1 pmane CS    408 Jul  2 2009 pmane_id.pub
-rwxr-xr-x  1 pmane CS    226 Jul 13 13:44 .soft
drwx-----  2 pmane CS   4096 Jul  6 2009 .ssh
-rw-----  1 pmane CS   5783 Jun  8 16:49 .viminfo
-rw-----  1 pmane CS    192 May  5 20:15 .Xauthority
-bash-3.2$
```

The terminal window also shows a status bar at the bottom: "Connected to grendel.hpcc.ttu.edu" and "SSH2 - aes128-cbc - hmac-md5 - n 80x31".

Step 2: setting up CPLEX environment

To run CPLEX on Hrothgar,

1. Add cplex to user environment by typing the command:
\$ soft add +cplex
2. To check the environment setting: which cplex
\$ which cplex

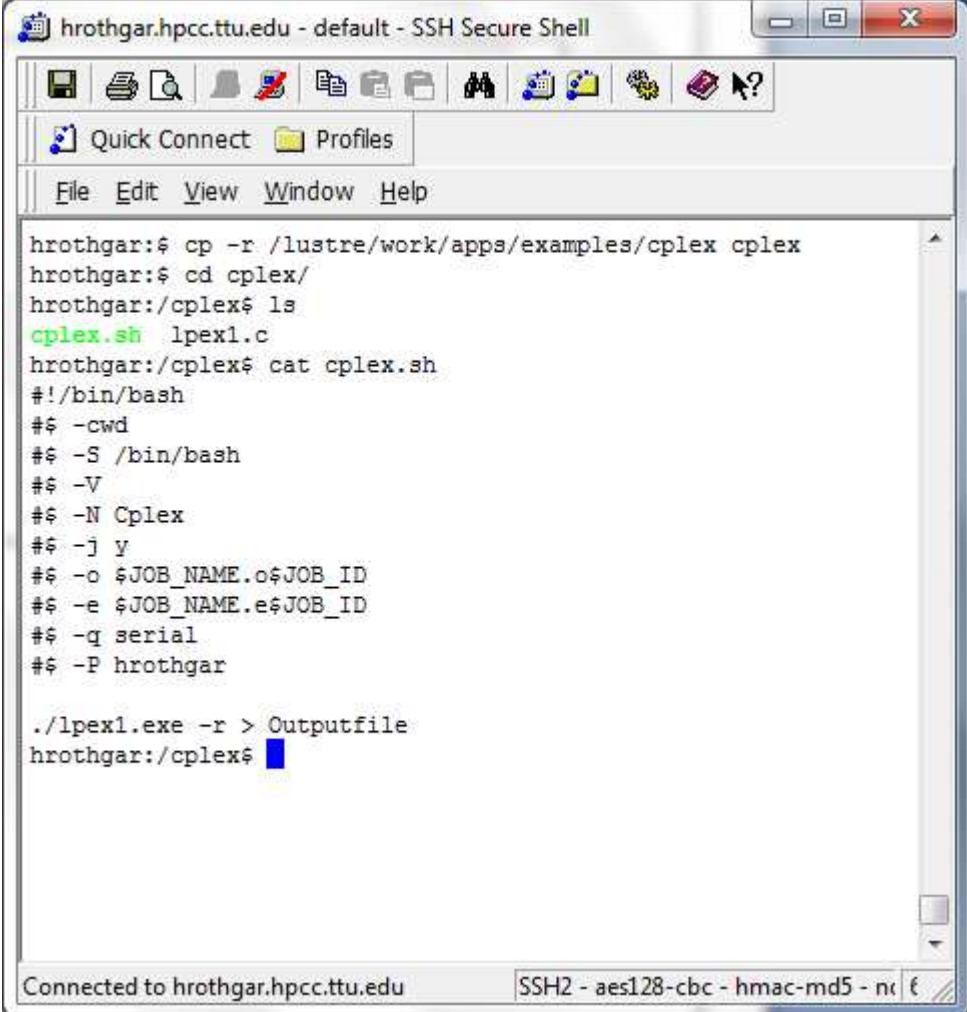


```
hrothgar.$ soft add +cplex
hrothgar.$ which cplex
/lustre/work/apps/ILOG/CPLEX_Studio_AcademicResearch122/cplex
/bin/x86-64_sles10_4.1/cplex
hrothgar.$
```

3. Job Submission User Guide

3.1. Script for Batchjob submission

The following is a script file (Cplex.sh) to submit a CPLEX job on Hrothgar. It assumes that input files are in the same directory with the script.



```
hrothgar.$ cp -r /lustre/work/apps/examples/cplex cplex
hrothgar.$ cd cplex/
hrothgar:/cplex$ ls
cplex.sh  lpex1.c
hrothgar:/cplex$ cat cplex.sh
#!/bin/bash
#$ -cwd
#$ -S /bin/bash
#$ -V
#$ -N Cplex
#$ -j y
#$ -o $JOB_NAME.o$JOB_ID
#$ -e $JOB_NAME.e$JOB_ID
#$ -q serial
#$ -P hrothgar

./lpex1.exe -r > Outputfile
hrothgar:/cplex$
```

3.2. Job submission

qsub cplex.sh - To submit your Cplexjob to Hrothgar

qstat – To check the status of the job

3.3 Interactive Job submission

Interactive jobs are currently only allowed in . Command To submit a job interactively on Hrothgar

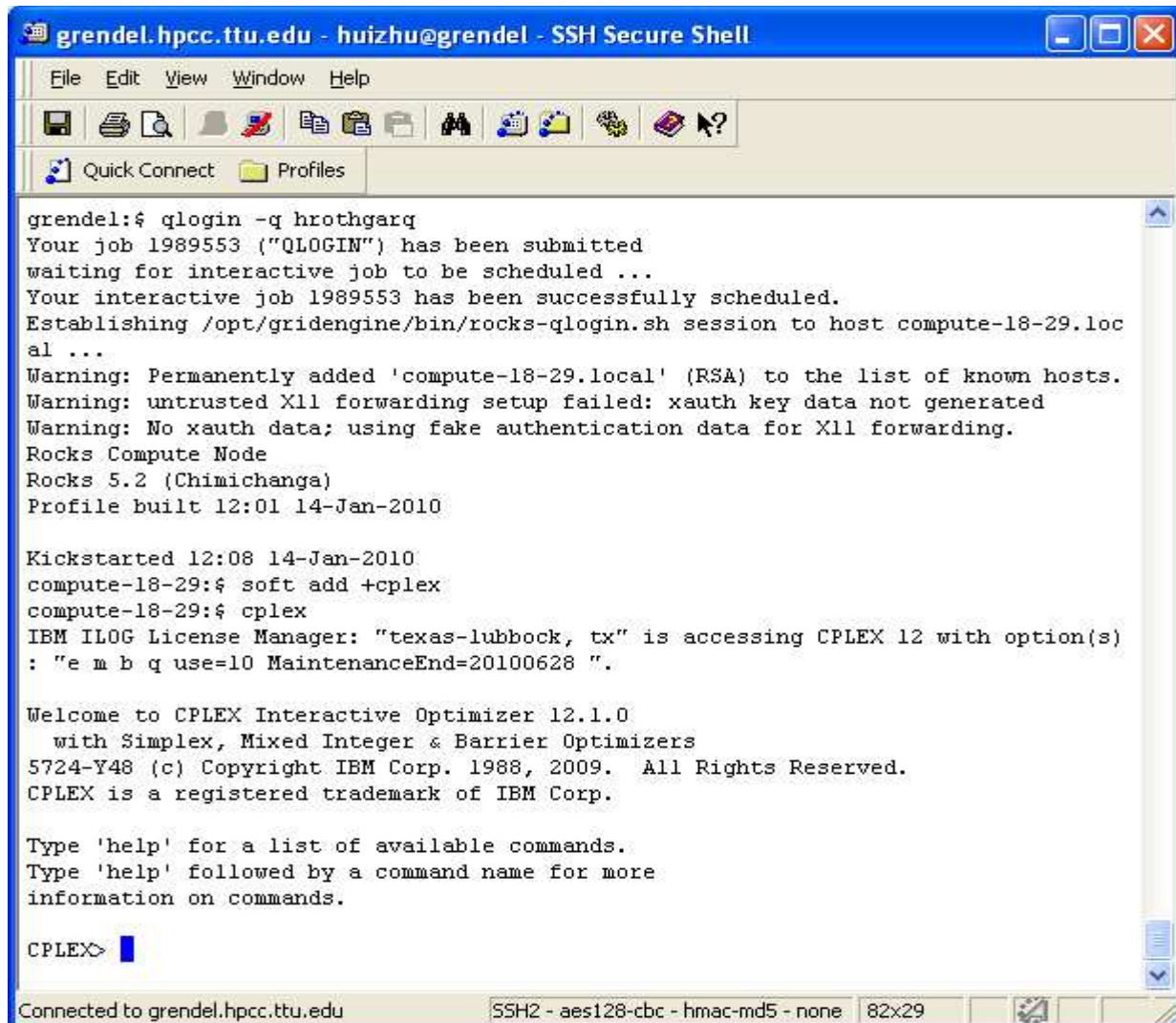
\$ qlogin -q serial -P hrothgar -pe fill 1

A node will be assigned for your job and user will be logged in to the node. Users need to add cplex to SoftEnv to set up the environment on the compute node.

```
$ soft add +cplex
```

To use cplex on this node type cplex

```
$ cplex
```



```
grendel.hpcc.ttu.edu - huizhu@grendel - SSH Secure Shell
File Edit View Window Help
[Icons]
Quick Connect Profiles

grendel:~$ qlogin -q hrothgarq
Your job 1989553 ("QLOGIN") has been submitted
waiting for interactive job to be scheduled ...
Your interactive job 1989553 has been successfully scheduled.
Establishing /opt/gridengine/bin/rocks-qlogin.sh session to host compute-18-29.local ...
Warning: Permanently added 'compute-18-29.local' (RSA) to the list of known hosts.
Warning: untrusted X11 forwarding setup failed: xauth key data not generated
Warning: No xauth data; using fake authentication data for X11 forwarding.
Rocks Compute Node
Rocks 5.2 (Chimichanga)
Profile built 12:01 14-Jan-2010

Kickstarted 12:08 14-Jan-2010
compute-18-29:~$ soft add +cplex
compute-18-29:~$ cplex
IBM ILOG License Manager: "texas-lubbock, tx" is accessing CPLEX 12 with option(s)
: "e m b q use=10 MaintenanceEnd=20100628 ".

Welcome to CPLEX Interactive Optimizer 12.1.0
with Simplex, Mixed Integer & Barrier Optimizers
5724-Y48 (c) Copyright IBM Corp. 1988, 2009. All Rights Reserved.
CPLEX is a registered trademark of IBM Corp.

Type 'help' for a list of available commands.
Type 'help' followed by a command name for more
information on commands.

CPLEX> 
```

4. Using CPLEX libraries to compile and link C code:

Example in /lustre/work/apps/examples/cplex directory

```
$ soft add +cplex
```

```
$ cp -r /lustre/work/apps/examples/cplex cplex
```

Step 1: Generate Object file

```
$ gcc -c -m64 -fPIC -I/$CPLXINC lpex1.c -o lpex1.o
```

Step 2: Link object file with cplex libs.

```
$ gcc -m64 -fpic -I/$CPLXINC lpex1.o -o lpex1.exe -L/$CPLXLIB -lcplex -lm -pthread
```

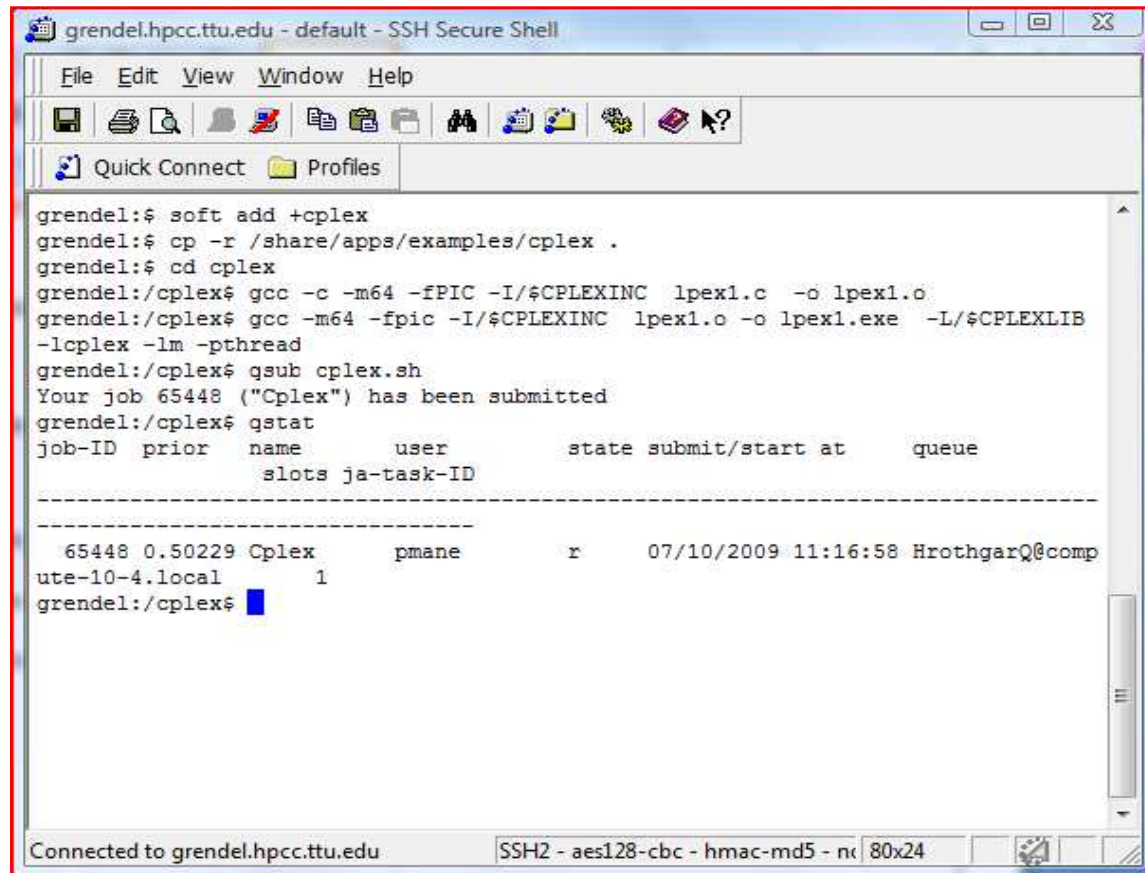
The script to submit this program is available in the same directory, called cplex.sh. It submit the job to run lpex1.exe, and write the output to the file "Outputfile".

```
#!/bin/bash
#$ -cwd
#$ -S /bin/bash
#$ -V
#$ -N Cplex
#$ -j y
#$ -o $JOB_NAME.o$JOB_ID
#$ -e $JOB_NAME.e$JOB_ID
#$ -q serial
#$ -P hrothgar

./lpex1.exe -r > Outputfile
```

Submit Test Job

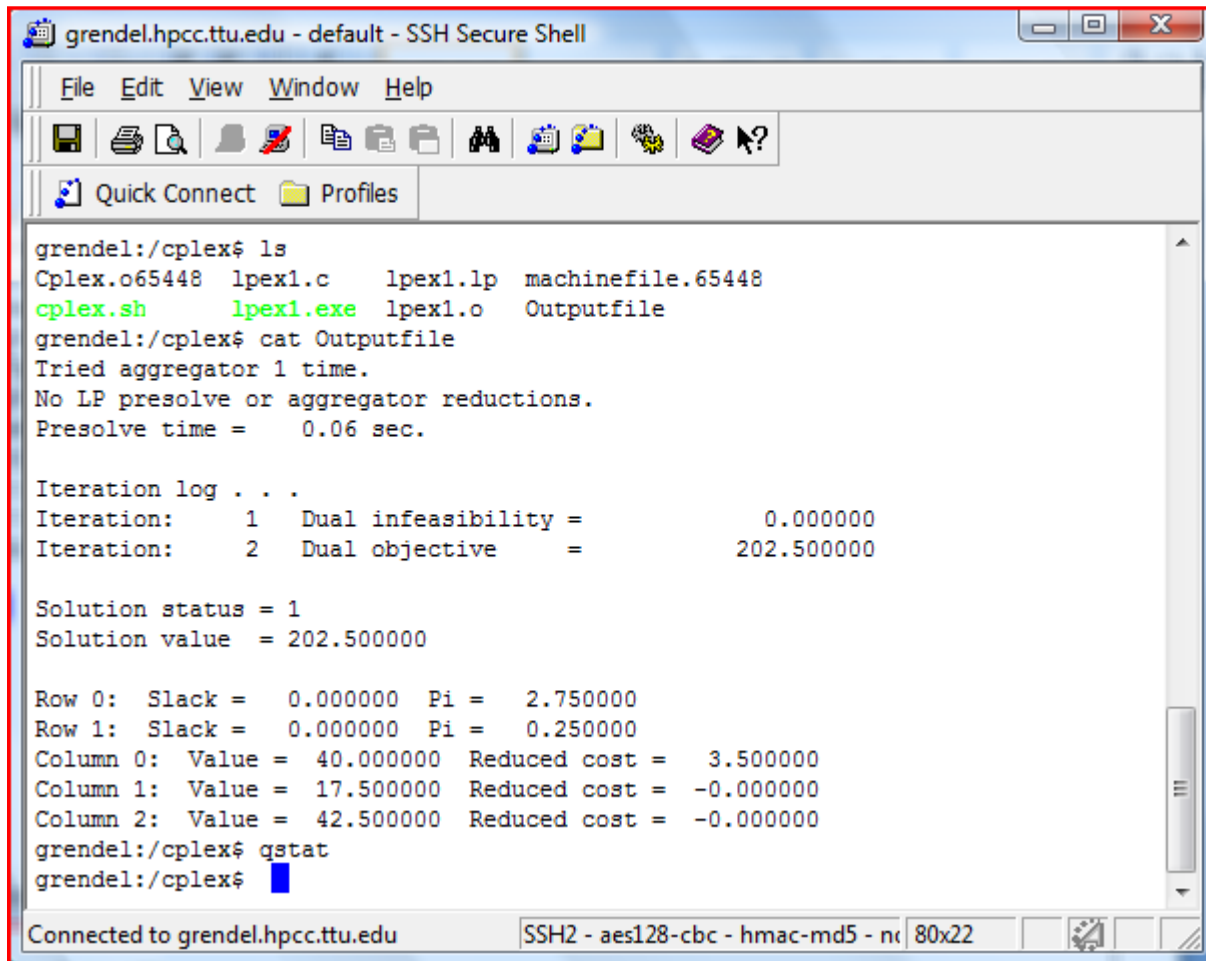
```
$ qsub cplex.sh
```



```
grendel:$ soft add +cplex
grendel:$ cp -r /share/apps/examples/cplex .
grendel:$ cd cplex
grendel:/cplex$ gcc -c -m64 -fPIC -I/$CPLXINC lpex1.c -o lpex1.o
grendel:/cplex$ gcc -m64 -fpic -I/$CPLXINC lpex1.o -o lpex1.exe -L/$CPLXLIB
-lcplex -lm -pthread
grendel:/cplex$ qsub cplex.sh
Your job 65448 ("Cplex") has been submitted
grendel:/cplex$ qstat
job-ID prior    name             user              state submit/start at   queue
-----
-----
65448  0.50229 Cplex             pmane             r      07/10/2009 11:16:58 HrothgarQ@comp
ute-10-4.local    1
grendel:/cplex$
```

Use command "cat Outputfile" to check the results when the job finishes.

\$ cat OutputFile



```
grendel:/cplex$ ls
Cplex.o65448  lpex1.c    lpex1.lp  machinefile.65448
cplex.sh     lpex1.exe  lpex1.o   Outputfile
grendel:/cplex$ cat Outputfile
Tried aggregator 1 time.
No LP presolve or aggregator reductions.
Presolve time = 0.06 sec.

Iteration log . . .
Iteration: 1 Dual infeasibility = 0.000000
Iteration: 2 Dual objective = 202.500000

Solution status = 1
Solution value = 202.500000

Row 0: Slack = 0.000000 Pi = 2.750000
Row 1: Slack = 0.000000 Pi = 0.250000
Column 0: Value = 40.000000 Reduced cost = 3.500000
Column 1: Value = 17.500000 Reduced cost = -0.000000
Column 2: Value = 42.500000 Reduced cost = -0.000000
grendel:/cplex$ qstat
grendel:/cplex$
```

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For Additional Assistance Contact: hpccsupport@ttu.edu

For Comments/Suggestions on user guide hpcc@ttu.edu

User Guide