Bag of Tasks Parallelism

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Slides:

https://github.com/timkphd/slides

Source

```
hexagon:~ tkaiser$ mkdir tut
hexagon:~ tkaiser$ cd tut
hexagon:tut tkaiser$ git clone https://github.com/timkphd/examples.git
Cloning into 'examples'...
remote: Enumerating objects: 83, done.
remote: Counting objects: 100% (83/83), done.
remote: Compressing objects: 100% (63/63), done.
remote: Total 1236 (delta 39), reused 45 (delta 19), pack-reused 1153
Receiving objects: 100% (1236/1236), 2.47 MiB | 3.64 MiB/s, done.
Resolving deltas: 100% (390/390), done.
hexagon:tut tkaiser$ mv examples/r .
hexagon:tut tkaiser$ rm -rf examples
hexagon:tut tkaiser$ cd r

hexagon:r tkaiser$ ./getdat.py
downloading file
True
split -l 158563 start start
hexagon:r tkaiser$ tar -xzf laser.tgz
hexagon:r tkaiser$

hexagon:r tkaiser$ Rscript doinstall.R
. . .
. . .
hexagon:r tkaiser$ R CMD SHLIB mapit.c
```

What if you have?

- A bunch of tasks to do
- They are all independent
- Similar, maybe just different input files
- Often called bag of task parallelism or embarrassingly parallel

bot.R

- Starts MPI
- ~~Splits the processors into two groups/communicators 0-(N-2) and (N-1)~~
- Processor (N-1) waits for "ready" from other processors, then sends work
- Rest of processors loop
  - send requests for work
  - do work (in this case generate plots)
  - send results

Bag of Tasks

This is a bag-of-tasks program. We define a manager task
that distributes work to workers. Actually, the workers
request input data. The manager sits in a loop calling
Iprobe waiting for requests for work.

In this case the manager reads input. The input is a list
of file names. It will send a entry from the list as
requested. When the worker is done processing it will
request a new file name from the manager. This continues
until the manager runs out of files to process. The
manager subroutine is just "manager"

The worker subroutine is "worker". It receives file names
form the manager.
#
The files in this case are outputs from an optics program
tracking a laser beam as it propagates through the atmosphere.
The workers read in the data and then create an image of the
data by calling the routine doplot This should worke
with arbitrary 2d files except the size in mkview.plotit is
currently hard coded to 64 x 64.

~~We use the call to "Split" to create a seperate communicator~~
~~# for the workers. This is not important in this example but~~
~~# could be if you wanted multiple workers to work together.~~

- Do initialization

```
MPI.Wtime<-function(){
return(0.0)
}
if (!is.loaded("mpi_initialize")) {
    library("Rmpi")
    }
mpi_comm_world<<-0
myid <<- mpi.comm.rank(comm=mpi_comm_world)
numprocs <<- mpi.comm.size(comm=mpi_comm_world)
myname <- mpi.get.processor.name()
paste("I R am",myid,"of",numprocs,"on",myname)
# num_used is the # of processors that are part of the new communicator #
# for this case hardwire to not include 1 processor #
   num_used<-numprocs-1
   mannum=0;
   if(myid == mannum){
      group<-0
   }else{
      group<-1
   }
```

- Create a communicator that contains everyone but the one process

```
# Rmpi does not support this....
# Split will create a set of communicators.  All of the
# tasks with the same value of group will be in the same
# communicator.  In this case we get two sets one for the
# manager and one for the workers.  The manager's version
# of the communicator is not used.
#
# DEFINED_COMM=mpi_comm_world.Split(group,myid)
#
# new_id=DEFINED_COMM.Get_rank()
# worker_size=DEFINED_COMM.Get_size()
# print("old id = %d   new id = %d   worker size = %d" %(myid,new_id,worker_size))
   DEFINED_COMM<-(-1)
```

- Manager is not part of “worker group”so she manages

```
    if(group == 0){
      todo=1000
# if not part of the new group do management. #
      manager(num_used,todo)
      print("manager finished")
      mpi.barrier(mpi_comm_world)
      bonk<-mpi.finalize()
    }else{
```

- Worker does this…

```
}else{
# part of the new group do work. #
 mannum=0;
 ts<-MPI.Wtime()
 idid=worker(DEFINED_COMM,mannum)
 te<-MPI.Wtime()
 print(paste("worker",myid,"finished",idid,"tasks in",te-ts,"seconds"))
 mpi.barrier(mpi_comm_world)
 bonk<-mpi.finalize()
}
```

- Workers tell manager they are ready
- Get work
- Do work
- Send Results

```
if (!is.loaded("mpi_initialize")) {
    library("Rmpi")
    }
mpi_comm_world<<-0
myid <<- mpi.comm.rank(comm=mpi_comm_world)
numprocs <<- mpi.comm.size(comm=mpi_comm_world)
myname <- mpi.get.processor.name()
paste("I R am",myid,"of",numprocs,"on",myname)
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# for this case hardwire to not include 1 processor #
   num_used<-numprocs-1
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   if(myid == mannum){
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   }else{
      group<-1
   }
```

- Manager
  - Gets input from stdin

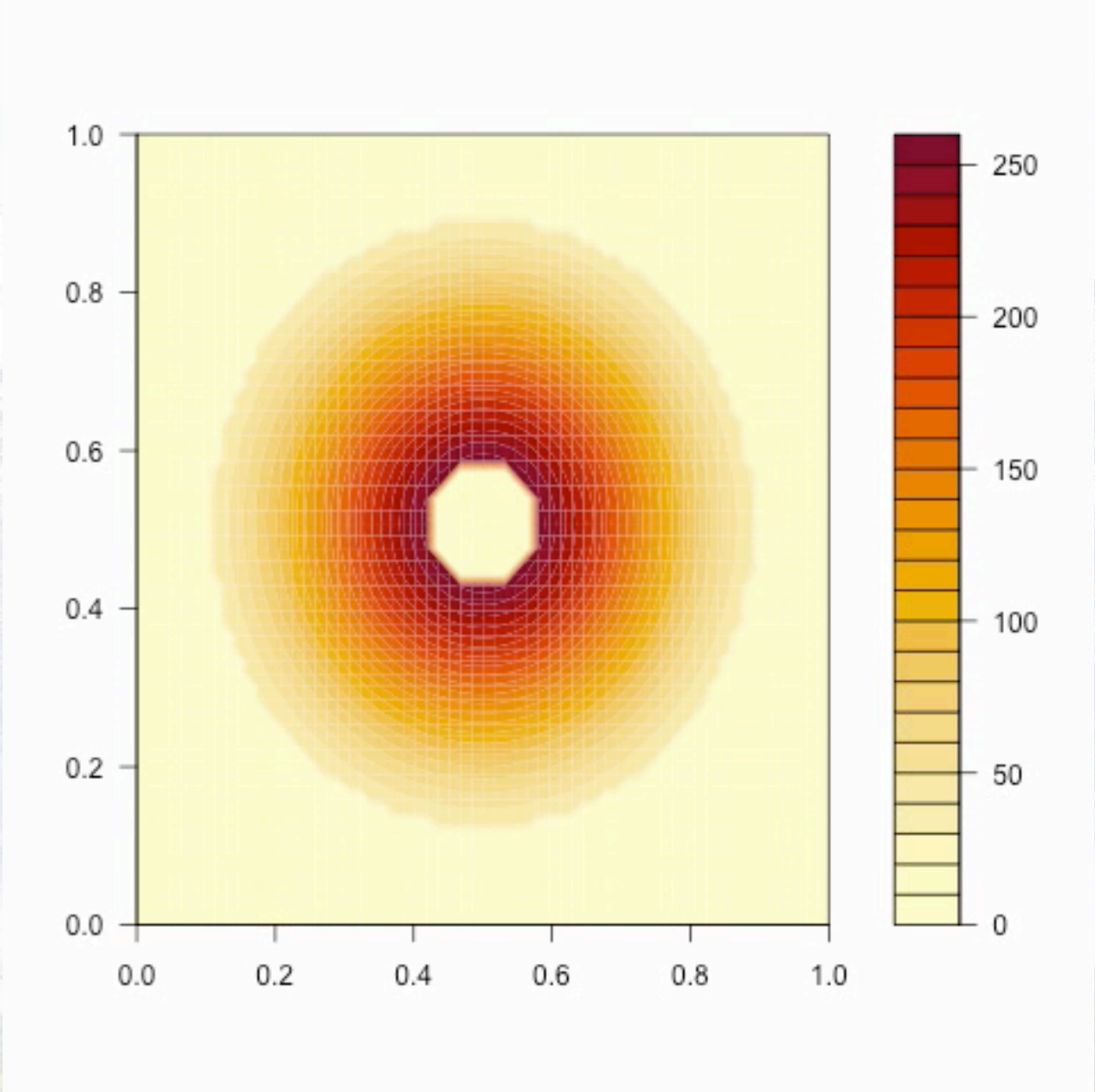
```
manager<-function(num_used,TODO){
# our "data"
# Our worker is expecting a single word
   mydat<-read.csv("infile",header=F)
   todo<-nrow(mydat)
   mydat<-as.vector(mydat$V1)
# counters
   igot<-0
   isent<-0
```

- Manager
  - Waits for ready
  - Sends work

```
   while(isent < todo){
# wait for a request for work #
      mystat<-as.integer(6789)
      flag<-mpi.iprobe(mpi.any.source(), tag=1234, comm = mpi_comm_world, status = mystat)
      if(flag){
# where is it comming from #
         gotfrom<-mpi.get.sourcetag(status = mystat)
         sendto<-gotfrom
         x=as.integer(-1)
         mystat<-as.integer(6789)
         x<-mpi.recv(x, 1, gotfrom, tag=1234,  comm=mpi_comm_world, status=mystat)
         print(paste("worker",gotfrom,"sent",x))
         if(x > -1){
            igot<-igot+1
            print(paste("igot",igot))
            }
         if(isent < TODO){
# send real data #
            send_msg=mydat[isent+1]
            mpi.send(send_msg, 3, sendto, tag=2345,  comm=mpi_comm_world)
            isent<-isent+1
         }
      }
   }
```

- Manager
  - Tells everyone to quit when work is finished

```
# tell everyone to quit #
   for (i in 1:numprocs-1){
      send_msg="stop"
      mpi.send(send_msg, 3, i, tag=2345,  comm=mpi_comm_world)
      }
   return( TRUE)
   }
```


1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
250
200
150
100
50
0