Applicazioni
in
Orca e Linda

Riferimenti

- Niholas Carriero, David Gelertner "How to Write Parallel Programs: A guide to the Perplex" from ACM Computing Surveys, vol. 21, No. 3, Sept. 1989, pp. 323-357, Copyright 1989, Association for Computing Machinery, Inc.
- ORCA: A LANGUAGE FOR PARALLEL

PROGRAMMING OF DISTRIBUTED SYSTEMS

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Programma per il calcolo dei numeri primi

```
Imain()
{
  int i, ok;
  for(i = 2; i < LIMIT; ++i) {
     eval("primms", i, is_prime(i));
  }
  for(i = 2; i <= LIMIT; ++i) {
     rd("primms", i, ? ok);
     if (ok) printf("%d\n", i);
  }
}
```

Finzione **`is-prime(...)`**

```
is-prime(me)
  int me;
{
  int=i, limit, ok;
  double sqrt();
  limit= sqrt((double) me) + 1;
  for (i=2; i < limit; ++i) {
      rd("primes", i, ? ok);
      if (ok && (me%i == 0)) return 0;
  }
  return 1;
}
```

Calcolo parallelo

```
#include "linda.h"
#define GRAIN 2000
#define LIMIT 1000000
#define NUM_INIT_PRIME 15
long primes[LIMIT/10+1] =
(2,3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47); long
    p2[LIMIT/10+1) =
{4,9,25,49,121,169,289,361,529,841,961,1369,
    1681,1849,2209};
lmain(argc, argo)
    int argc;
    char *argo[];
```

Calcolo parallelo

```
{
   int eot, first_num, i, nun, num_primes, num_workers;
   long new_primes[GRAIN], np2;
   num_workers = atoi(argv[1]);
   for (i = 0;   i < num_workers; ++i)
         eval(“worker", worker());
   num_primes = NUM_INIT_PRIME;
   first nun = primes[num_primes-1] + 2;
   out("next task", first nun);
   eot = 0; /* becomes 1 at "end of table" -- i.e., table
   complete*/
```

Calcolo parallelo

```
for (num = firstnum; num < LIMIT; num += GRAIN) {
        in("result", num, ? new_primes: size);
        for (i =0; i < size; ++i, ++num_primes) {
                primes[num_primes] = new_primes[i];
                if(!eot)
                        np2 = new_primes[i]*new_primes[i];
                        if (np2 > LIMIT) {
                                eot = 1;
                                np2 = -1;
                        }
                out("primes", num_primes, new_primes[i], np2);
        }
}
}
```

Calcolo parallelo

```
/* " ? int" means "match any int; throw out
   the value"*/
    for (i = 0; i < nun_workers; ++i)
        in("workers",?int)
   printf("'%d: %d\n", num_primes,
   primes[num_primes-1]);
    }
}
```

Calcolo parallelo

```
worker() {
   long count, eot, i, limit, num, num_primes, ok,
   start;
   long my_primes[GRAIN];
   num_primes = NUM_INIT_PRIME;
   eot = 0;
   while(1) {
      in("next task", ? num);
      if (num == -1) {out("next task", -1);return;}
```

Calcolo parallelo

```
limit = num + GRAIN;
out("next task", (limit > LIMIT) ? -1 : limit);
if (limit > LIMIT) limit = LIMIT;
start =num;
for (count = 0; num < limit; num +- 2) {
    while (!eot && nun > p2[num-primes-1]) {
        rd("primes", num primes, ? primes [nun-primes], ?
p2[num-primes]);
        if (p2[num-primes] < 0)
            eot = 1;
        else
            ++num_primes;
}
```

Calcolo parallelo

```
    for (i = 1, ok = 1; i < num_primes; ++i)
            if (!(num%primes[i])) {
                    ok = 0;
                    break;
            }
            if (num < p2[i]) bleak;
            }
    if (ok) {
            my_primes[count]=num;
            ++count;
    }
}
    /• Send the control process any primes found.
    out("result', start, my-primes: count);
}/*While(1)*/
} /*classe*/
```

Orca

generic (**type** T)

object specification GenericJobQueue;

operation AddJob(job: T); # add a job to the tail of the queue

operation NoMoreJobs(); # invoked when no more jobs will be added

operation GetJob(job: **out** T): boolean;

Fetch a job from the head of the queue. This operation

fails if the queue is empty and NoMoreJobs has been invoked.

end generic;

Coda di Job

```
generic
object implementation GenericJobQueue;
    type ItemName = nodename of queue;
    type queue =
        graph # a queue is represented as a linear list
            first, last: ItemName; # first/last element of queue
        nodes
            next: ItemName; # next element in queue
            data: T; # data contained by this element
        end;
    done: boolean; # set to true if NoMoreJobs has been invoked.
    Q: queue; # the queue itself

begin # Initialization code for JobQueues ; executed on object creation.
    done := false; # initialize done to false
end generic;
```

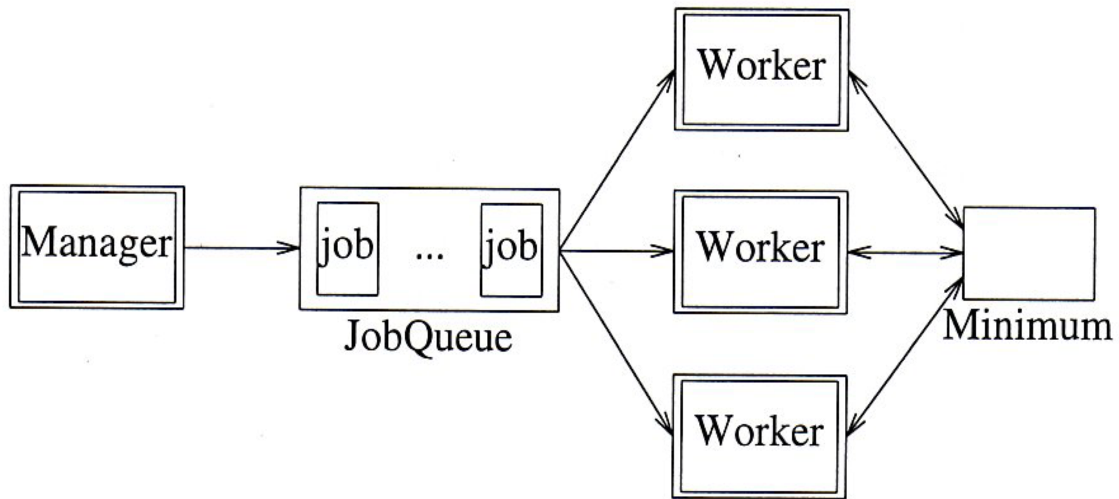
Coda di Job

```
operation AddJob(job: T);
        p: ItemName;
   begin # add a job to the tail of the queue
        p := addnode(Q); # add a new node to Q, return its name
   in p
        Q[p].data := job; # fill in data field of the new node; next
   field is NIL
        if Q.first = NIL then # Is it the first node?
                Q.first := p; # yes; assign it to global data field
        else
                Q[Q.last].next := p; # no; set predecessor's next field
        fi;
        Q.last := p; # Assign to "last" global data field
   end;
```

Coda di Job

```
operation NoMoreJobs();
    begin # Invoked to indicate that no more jobs will be added
        done := true;
    end;
    operation GetJob(job: out T): boolean;
        p: ItemName;
    begin # Try to fetch a job from the queue
        guard Q.first /= NIL do # A job is available
            p := Q.first; # Remove it from the queue
            Q.first := Q[p].next;
            if Q.first = NIL then Q.last := NIL; fi;
            job := Q[p].data; # assign to output parameter
            deletenode(Q,p); # delete the node from the queue
            return true; # succeeded in fetching a job
        od;
        guard done and (Q.first = NIL) do
            return false; # All jobs have been done
        od;
    end;
```

TSP



TSP Orca

type PathType = **array**[integer] **of** integer;
type JobType =
record
len: integer; # length of partial route
path: PathType;# the partial route itself
end;
type DistTab = ...; # distances table
object TspQueue = **new**
GenericJobQueue(JobType);
# Instantiation of the GenericJobQueue type

TSP Orca

```
process master();
minimum: IntObject; # length of current best path (shared
    object)
q: TspQueue; # the job queue (shared object)
i: integer;
distance: DistTab; # table with distances between cities
begin
    minimum$assign(MAX(integer)); # initialize minimum to infinity
    for i in 1.. NCPUS() - 1 do
        # fork one worker per processor, except current processor
        fork worker(minimum, q, distance) on(i);
    od;
    GenerateJobs(q, distance); # main thread generates the jobs
    q$NoMoreJobs(); # all jobs have been generated now
    fork worker(minimum, q, distance) on(0);
    # jobs have been generated; fork a worker on this cpu too
end;
```

TSP Orca

```
process worker(
    minimum: shared IntObject; # length of current best path
    q: shared TspQueue; # job queue
    distance: DistTab) # distances between cities
    job: JobType;
begin
    while q$GetJob(job) do # while there are jobs to do:
    tsp(job.len, job.path, minimum, distance);
    # do sequential tsp
    od;
end;
```