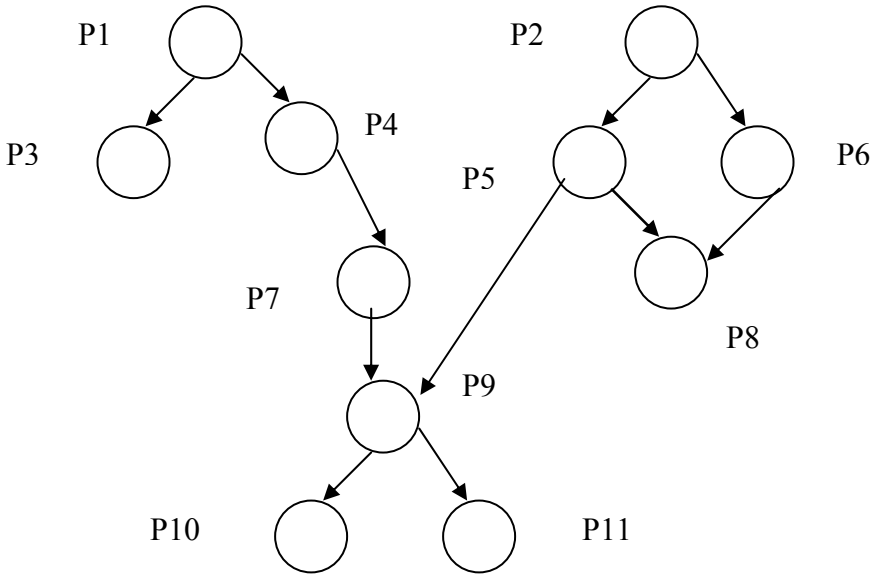
SYSC-5207 Distributed Systems Engineering (Fall 2014)

Assignment 1

Show your work. Justify your answers.

[Students will work in groups (of two) that have already been determined. Each group must hand in only ONE set of solutions to the problems]

1. Consider the following precedence graph



(a) Write the complete specification (list of processes and partial order) for π

(b) Four memory locations are accessed by the computation. Consider the following memory specifications for π described earlier:

	Domain	Range
P1	{M4}	{M1}
P2	Φ	(M2}
P3	{M1}	{M2}
P4	{M1}	Φ
P5	{M2}	{M4}
P6	{M2}	Φ
P7	{M3}	{M1}
P8	{M4}	{M2}
P9	{M1}	Φ
P10	Φ	{M1}
P11	{M3}	Φ

(i) Is the computation determinate? If not what minimal changes in the precedence graph are required to make it determinate?

(ii) If your answer to (i) was yes, is the computation maximally parallel?

2. Consider the following concurrent computation comprising multiple processes modeled by using the parbegin-parend construct. Generate a model for the computation using the linear representation of parallelism (based on the fork join and quit constructs)

```
parbegin

        {P1;

        parbegin
                P2;
                P3;
                {P11;
                 P12}
        parend

        P5;

        parbegin
                P6;
                P7;
                P8
        parend

        P9;
        P10
        }

        P4
parend
```

3. Consider the following parallelism profile. The degree of parallelism d is specified for each instant of time t;

t	1	2	3	4	5	6	7	8	9	10	11	12
d	1	1	3	3	3	5	5	1	3	3	5	1

(a) Draw the *Shape* for the application
(b) Draw the speedup vs number of processors graph for the application
[Use the Processor Sharing scheduling discipline to compute the completion times]
(c) Compute the Average Parallelism for the application
(d) Draw a graph displaying the upper and lower bounds on Speedup based on Average Parallelism
[For each of the graphs in (b) and (d) include a table showing the x-axis and y-axis values]

4. Consider the precedence graph shown at the beginning of question 1. The execution time (in seconds) for each process is specified in the following table.

Process	P1	P2	P3	P4	P5	P6	P7	P8	P10	P11
Execution Time (sec)	10	30	15	6	6	3	3	20	10	5

a) Draw the parallelism profile for the application.

(b) Draw the *Shape* for the application.

(c) Compute the values of maximum parallelism (m) and fraction of sequential work (f) for the application

5. Consider the upper (U) and lower (L) bounds on speedup based on average parallelism A: U = min (N, A) and L = NA/(N+A-1). Let E be an estimate of the actual value of speedup, S(N), that is equal to the mid point between the two bounds U and L. Determine the maximum value of the relative error associated with E. Note that relative error is determined as the ratio between $| E - S(N) |$ and S(N).

Posted: October 8
Due: October 22 (in class)