2)

For each generation (given fitness is known), we calculate next generation and calculate the fitness of that generation.

**1 processor:**

One processor needs to do all algorithmic calculations (50s) plus time for each offspring (. Note, there is no communication time.

Each generation: .

So, total time is

**20 processors:**

One processor needs to do all algorithmic calculations (50s) plus each of the 20 processors will need time for each offspring . There is communication time: each of the 20 processors will need to spend 10s communicating

Each generation:

So, total time is

**22 processors:**

Same as 20 processor, since you cannot break up the task into more than 20 subtasks.

Total time is

2a)

If wall clock time is .

2b)

Same thing since we cannot break up the task into more than 20 subtasks:

Wall clock time: 30000s, and speedup = 3.5

3c)

For 20 processors:

To get an efficiency of at least 0.8,

For 22 processors:

To get an efficiency of at least 0.8,

For 22 processors, even though it takes the same amount of time to finish the task, the efficiency decreased because there will be 2 processors that don’t have anything to do. In addition, needs to increase asymptotically to increase efficiency since it is impossible for efficiency to be 1 unless .