## Assignment 1

### Part 1

Solution provided in code and can be found in the zip file.

### Part 2

The appropriate points are circled in red, representing the inter-node scaling at 20, 40, 60, and 80 processes. The other points from 1-20 processes are not appropriate for Amdahl's law fitting because within a socket all cores are competing for shared memory bandwidth, leading to saturation effects that create a bottleneck. This violates the model's assumption of scalable resources (Lecture 1, Slide 40). In order to fit Amdahl's law, we use inter-node scaling where intra-socket communication overhead is not the limiting factor. We define the first node (20 processes) as the scaling baseline, following the methodology shown in Lecture 1, Slide 40
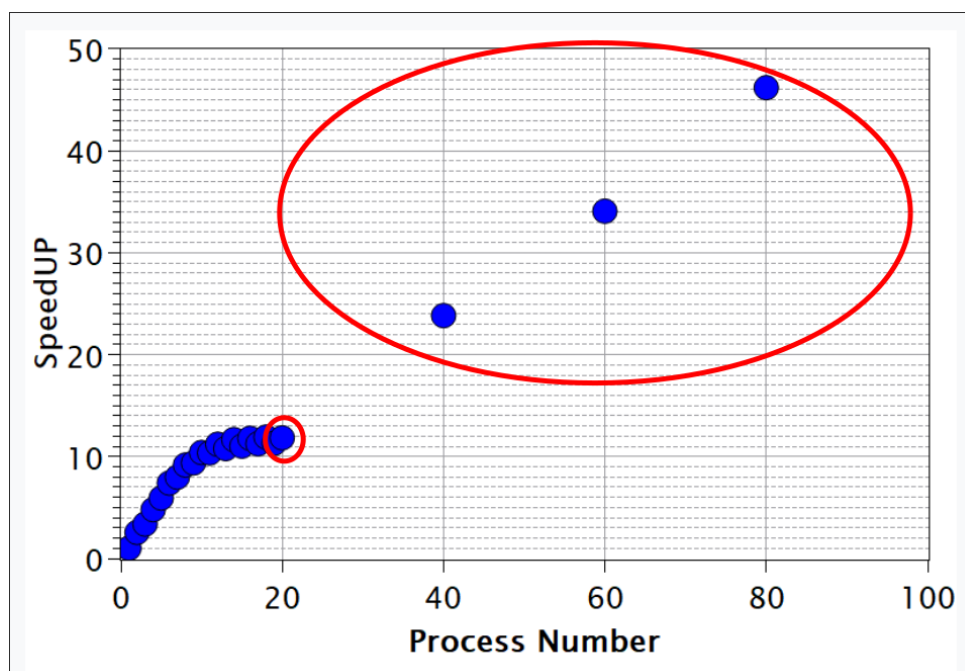


**Figure 1:** Appropriate data points shown in red circle

#### Serial fraction

Using the first node as our scaling baseline, we divide all speedup values by the speedup at 20 processes, resulting in the following rebased values. (Note: We now express parallelism in terms of nodes $N$,

where 1 node equals 20 processes)

$$S(1) = \frac{12}{12} = 1 \tag{1}$$

$$S(2) = \frac{24}{12} = 2 \tag{2}$$

$$S(3) = \frac{34}{12} = \frac{17}{6} \tag{3}$$

$$S(4) = \frac{46}{12} = \frac{23}{6} \tag{4}$$

$$\tag{5}$$

We can now compute the serial fraction for $N = 4$ Nodes:

$$S(N) = \frac{1}{s + \frac{1-s}{N}} \tag{6}$$

$$\frac{23}{6} = \frac{1}{s + \frac{1-s}{4}} \tag{7}$$

$$s + \frac{1-s}{4} = \frac{6}{23} \tag{8}$$

$$4s + (1-s) = \frac{24}{23} \tag{9}$$

$$3s + 1 = \frac{24}{23} \tag{10}$$

$$3s = \frac{24-23}{23} \tag{11}$$

$$s = \frac{1}{23 \cdot 3} \approx 0.01449 \tag{12}$$

Therefore approximately 1.45% of the code is serial.