



Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Parallel Programming
Solution 5: Basic Parallel Programming Concepts
Spring Semester 2017

Assigned on: **21.03.2017**

Due by: **27.03.2017**

Task 3 – Task graph

Assuming you want add eight numbers, then two options to do this are

$$\begin{array}{c} 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 \\ \underbrace{\hspace{1.5cm}}_{+} \\ \underbrace{\hspace{1.5cm}}_{+} \\ \underbrace{\hspace{1.5cm}}_{+} \\ \underbrace{\hspace{1.5cm}}_{+} \\ \underbrace{\hspace{1.5cm}}_{+} \\ \underbrace{\hspace{1.5cm}}_{+} \end{array}$$

and

$$\begin{array}{c} 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 \\ \underbrace{\hspace{1.5cm}}_{+} \quad \underbrace{\hspace{1.5cm}}_{+} \quad \underbrace{\hspace{1.5cm}}_{+} \quad \underbrace{\hspace{1.5cm}}_{+} \\ \underbrace{\hspace{3.5cm}}_{+} \quad \underbrace{\hspace{3.5cm}}_{+} \\ \underbrace{\hspace{7cm}}_{+} \end{array}$$

- a) Given those two variant, determine the length of the critical path for both

Answer: In the first version we always have to wait for the previous addition to finish, before we can start the following one. This causes us to have seven additions that can not be executed in parallel, which form the critical path. In the second version we can do all additions on the same level at the same time. We finish the whole task after 3 levels which is the length of the critical path.

- b) For a sequence of length n , determine the length of the critical path using the approaches from above.

Answer: In the first version we add all the numbers in a serial fashion - therefore the length of the critical path is equal to the length of the set of numbers minus one.

$$n - 1$$

In the second version we do as many independent additions in parallel as possible resulting in a tree structure for the task graph. The critical path is equal to the height of this tree which is

$$\lceil \log_2(n) \rceil$$