

Introduction

The purpose of the *Algorithms for Skyscrapers* project is for students to acquire basic computational problem solving skills and become familiar with the *flowchart* and *pseudocode* representations of algorithms. Students will have to design their own algorithms to solve a given problem.

Tasks

The *Burj Khalifa* in *Dubai, United Arab Emirates* is currently the tallest man-made structure in the world, at 829.8 m (2,722 ft). Furthermore, the *Kingdom Tower* in *Jeddah, Saudi Arabia* is a skyscraper currently under construction. If completed as planned, the tower will reach unprecedented heights, becoming the next tallest building in the world, as well as the first structure to reach the 1-km (3,281-ft)-high mark.

In order to build the next-generation tallest skyscrapers in the world in the shortest possible time, a *prefabricated-modular-block* construction method will be adopted. Each block of 100 meters long, 100 meters wide, and 5 meters tall will be prefabricated and assembled. The blocks interlock on top and bottom (like Legos), and they cannot be stacked sideways. Using special lifters, **putting stacks of blocks of the same heights on ground or on top of another set of equal-height stacks takes one week regardless of how tall the stacks are or how many stacks are lifted**. In addition, the prefabrication time of the blocks doesn't count since they are already in stock.

The problem has two parts:

- (1) If a client wants to build a 100-meter long, 100-meter wide, and M -meter high tower as quickly as possible. M has different values depending on your assignment ($M = \{1050, 1260, 1400, 1450, 1500, 1200, 1620, 1800, 1740\}$). There is no resource and budget limitation (i.e., you can have as many stacks as possible at the same time). However, you are not allowed to use more blocks than you actually need for the skyscraper. What is the shortest amount of time that it will take to build the tower? Show your algorithm in both *flowchart* format.
- (2) Develop a general algorithm for skyscrapers of 100-meter long, 100-meter wide, and N -meter high (where N is a multiple of 5) in *flowchart* and *pseudocode* formats.



Suggestions:

- Use something like *Legos* or a graph to help solve this problem.
- Start with a smaller tower—solve a smaller problem.
- Extend that knowledge to the larger problem.

Deliverable

1. A technical report in *Microsoft Word* format including (1) *flowchart* representation of your algorithm to build a M -meter high skyscraper, and show the shortest amount of time that it will take to build the M -meter high tower using your algorithm. Also include a general algorithm in (2) *flowchart* and *pseudocode* representations for skyscrapers of N -meter high (where N is a multiple of 5).
2. Project groups should be ready to demonstrate and explain their algorithms to the class.

