CSC 4104

Information System -Planning Tasks

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http://jpaulgibson.synology.me/~jpaulgibson/TSP/Teaching/CSC4104/CSC4104-InformationSystem-PlanningTasks.pdf

Task Graphs: a simple yet powerful tool

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Problem *Structure* <--…………….--> Solution *Structure*

Large gap => try an intermediate step

Problem ---> Task Graph ---> Solution

How to:

Problem -> Task Graph

split problem into tasks

Task Graph -> Solution

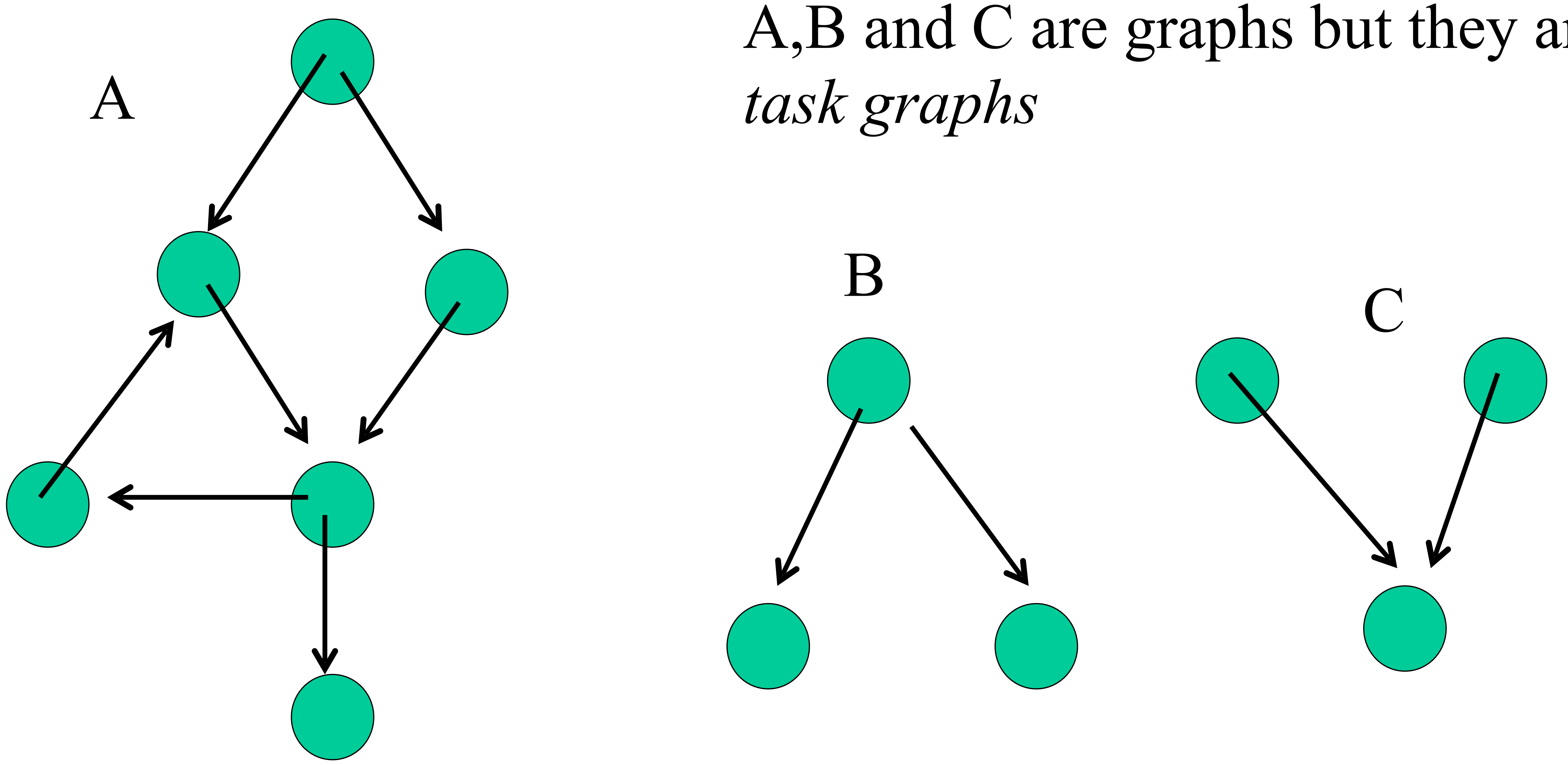
map tasks to **parallel resources**

What Is A Task Graph?

A *task graph* is a graph which has:

1 *root*, 1 *leaf*, no *cycles* and all *nodes connected*

A,B and C are graphs but they are not *task graphs*



Why are task graphs useful?

They help to identify an important property of the problem:

task dependency

They provide a formal model for scheduling which is amenable to:

rigorous mathematical analysis

They are simple, yet very powerful because they can be communicated to clients, managers and engineers:

non-ambiguous common language

There are standard extensions to the model which guard the simplicity and intuitiveness, but also enrich the semantics

HOW: Problem ---> Task Graph

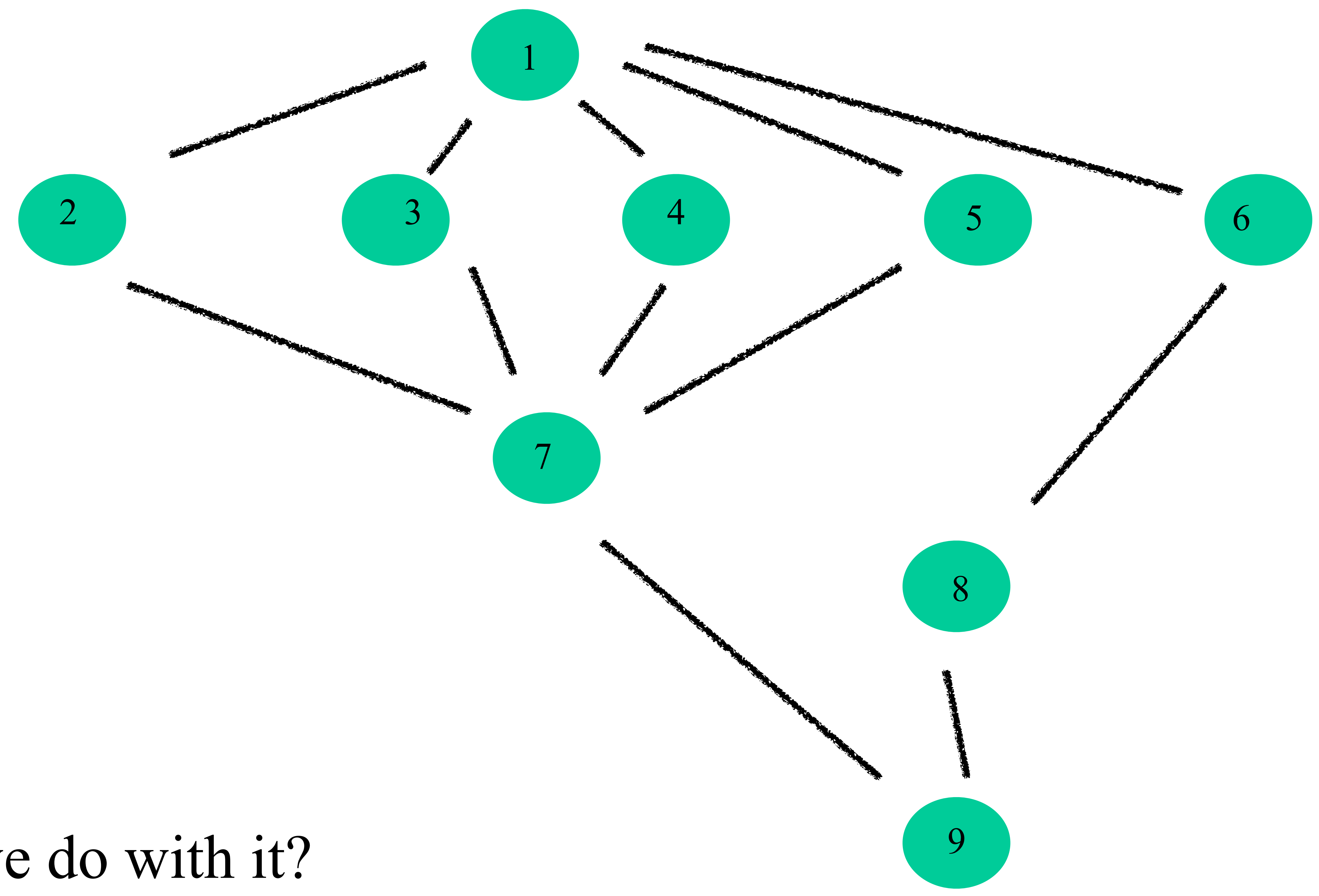
Task graphs are useful, but how do we create them?

There is a standard, informal, algorithm:

- Divide problem into set of n tasks
- Every task becomes a node in the task graph
- If task(x) cannot start before task(y) has finished then draw a line from node(y) to node(x)
- Identify (or create) starting and finishing tasks

The process (execution) flows through the task graph almost like *pipelining* in a single processor system

A Typical Task Graph



Question --- what can we do with it?

Answer --- we can construct *task sequences*

Task Sequences

A *task sequence* for a task graph, TG say,shows all *valid schedules* of the problem

ts =t1,…,tn is a valid task sequence for TG iff

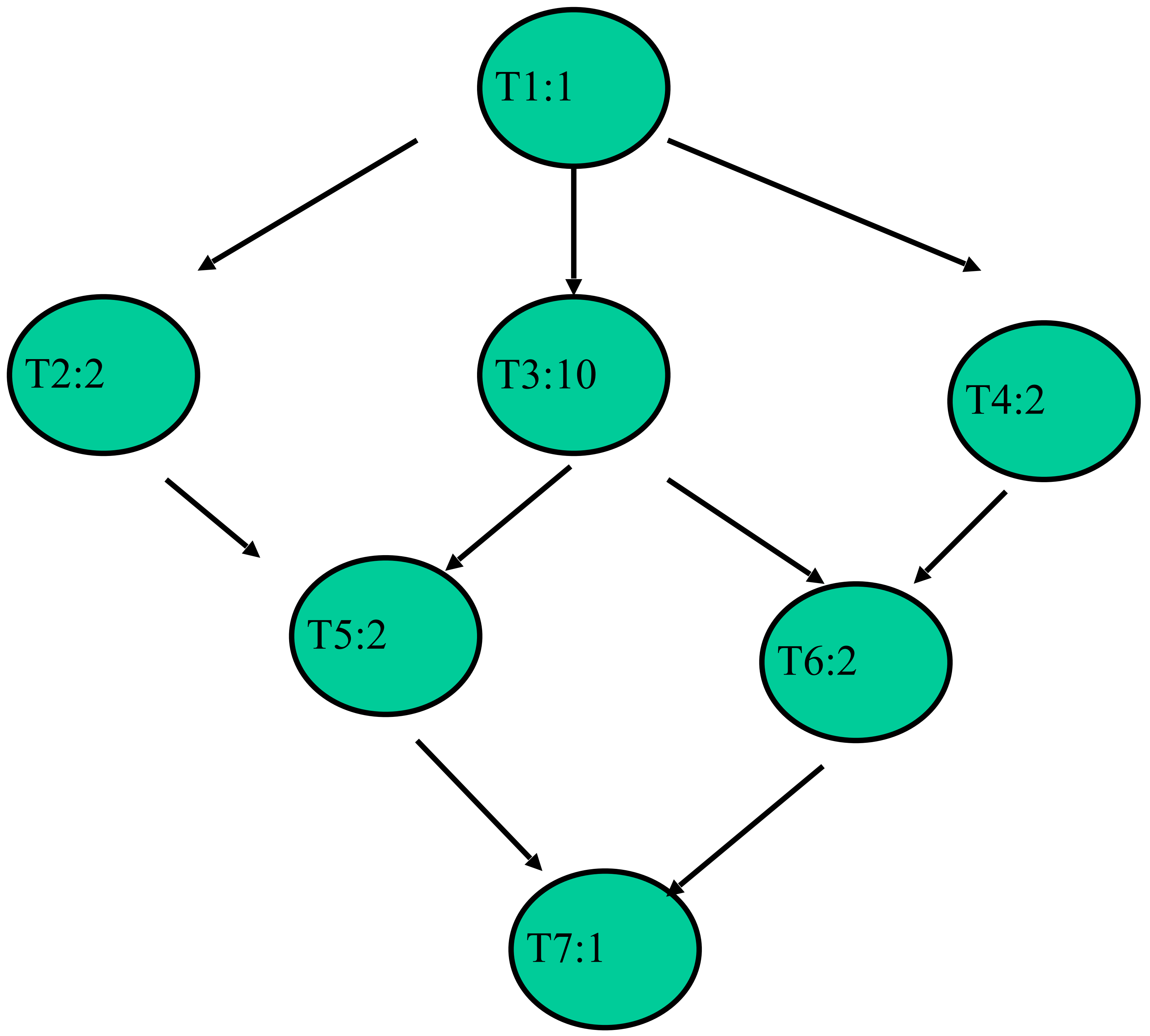
- t1 is a root node
- tn is a final (leaf) node
- there is a *1-1 and onto* mapping (isomorphism) between the tasks and the nodes in TG
- for all pairs of tasks ti,ti+1 in the sequence, there is no path from ti+1 to ti in TG

Annotated Task Graphs

In an annotated task graph:

For each task we annotate the TG with a value corresponding to *'task time'*

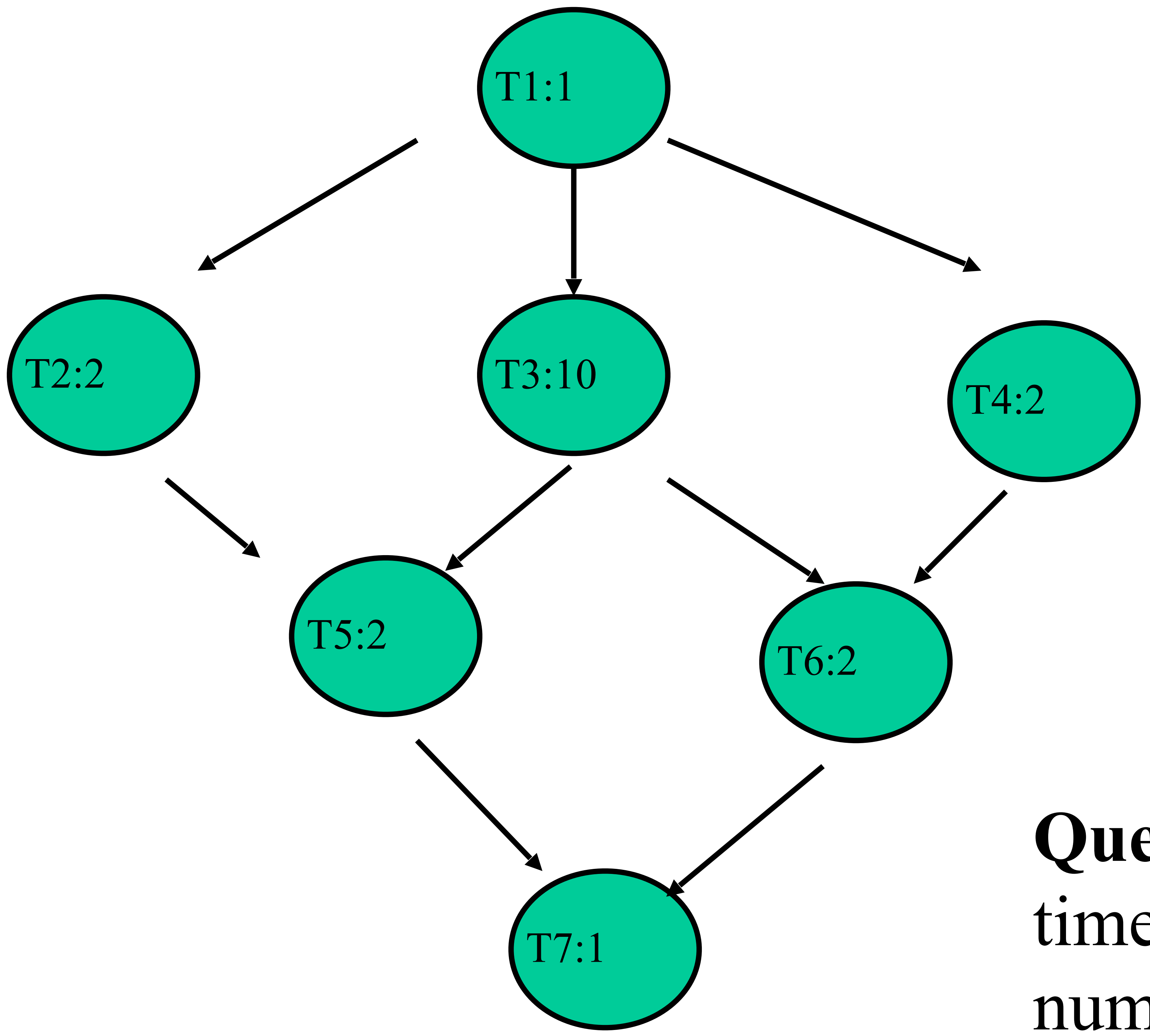
For example,



Annotated Task Graphs

With 1 person, any task sequence will have an *execution time* = 1+2+10+2+2+2+1 = 20

Goal: using people in parallel, reduce execution time

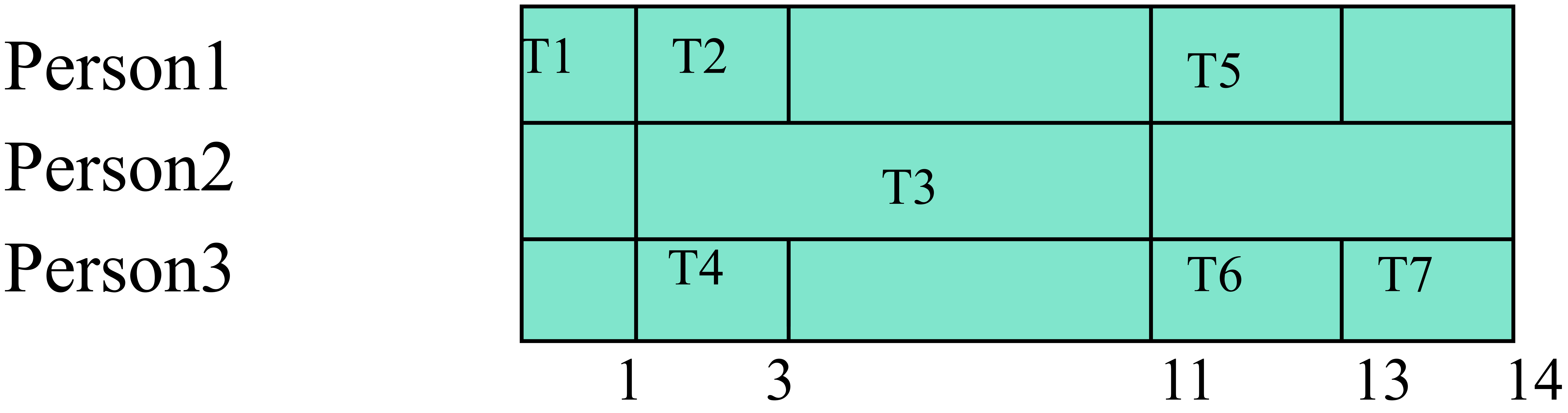


Question: what would our best execution time be in a system with an *unbounded* number of people?

Gantt Charts: Another useful structure transformation tool

To map a TG onto a parallel schedule, we use a *Gantt Chart*

Example: our previous example with 3 people



Here, we have:

•*execution time* = 14,

•*speed up* = time for single person/ new *execution time* = 20/14 = 1.4

•*efficiency* = speed up / number of people = 1.4/3 = 0.5

A First Analysis

In the previous problem, we did our analysis on a bounded number of people … why? … and why did we chose 3?

Question: how well could we do with more than 3 people?

Question: how well could we do with only 2 people?

Question: why should we target our analysis on Task **T3**?

Potential improvement: split **T3** into subtasks and try again … this is known as a *task graph transformation*

Graph Transformation

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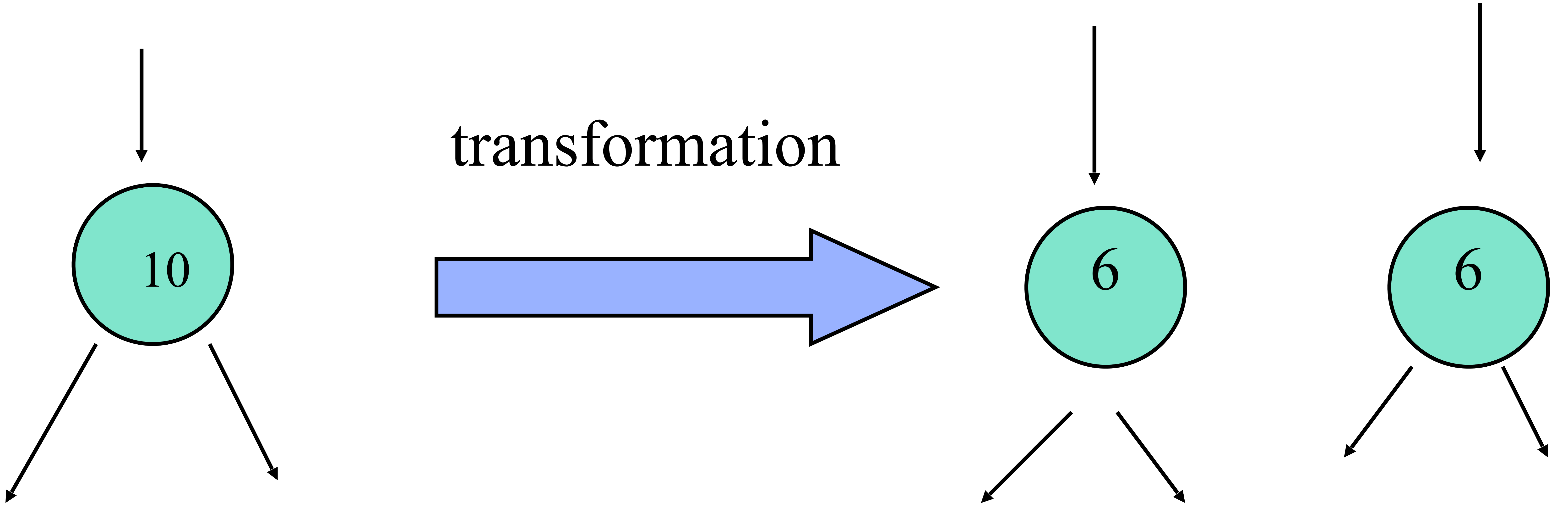
Task Graph *Transformation* ---

T3 appears to be the *problem task* … what can we achieve if we divide it into 2 tasks. For example, two tasks taking *6 units* execution time each ---



Note: the transformation has cost us in terms of total work required --- it often costs more to split something up --- but the added structure means we can reduce execution time using parallel resources.

Question: after this transformation, can we do better with 3 people?

But Task Graph Modelling Is not just a mathematical problem

What are the human issues that need to be taken into account?

What does the model not consider (abstract away from)