The Happy, the Sad, and the Unknown

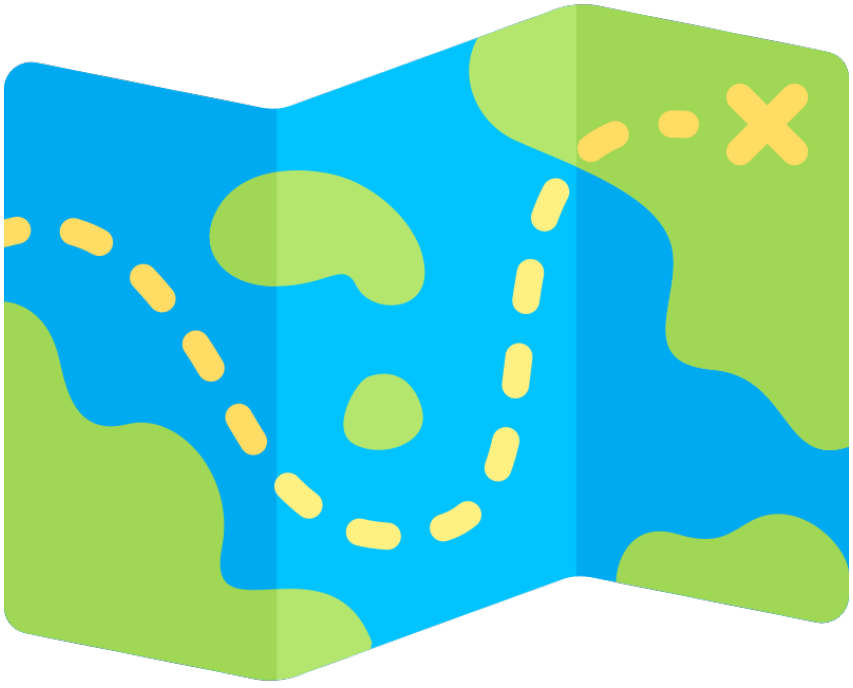
Program Analysis and Automated Scheduling For Fault-Tolerant Workflows

Markus Klinik
June 10, 2021

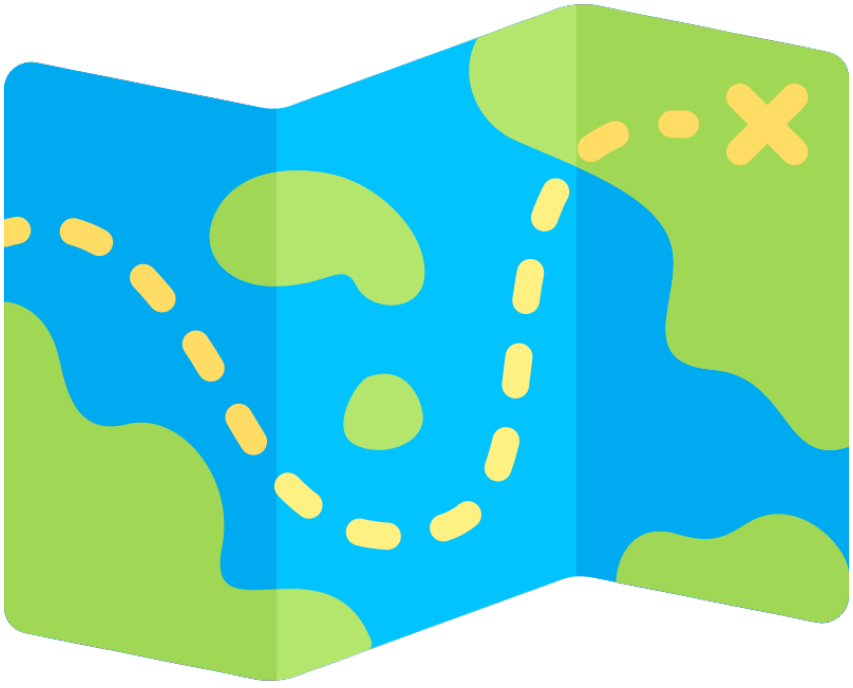
Institute for Computing and Information Sciences
Radboud University

Goals and Plans

Everything Starts With a Goal



Everything Starts With a Goal

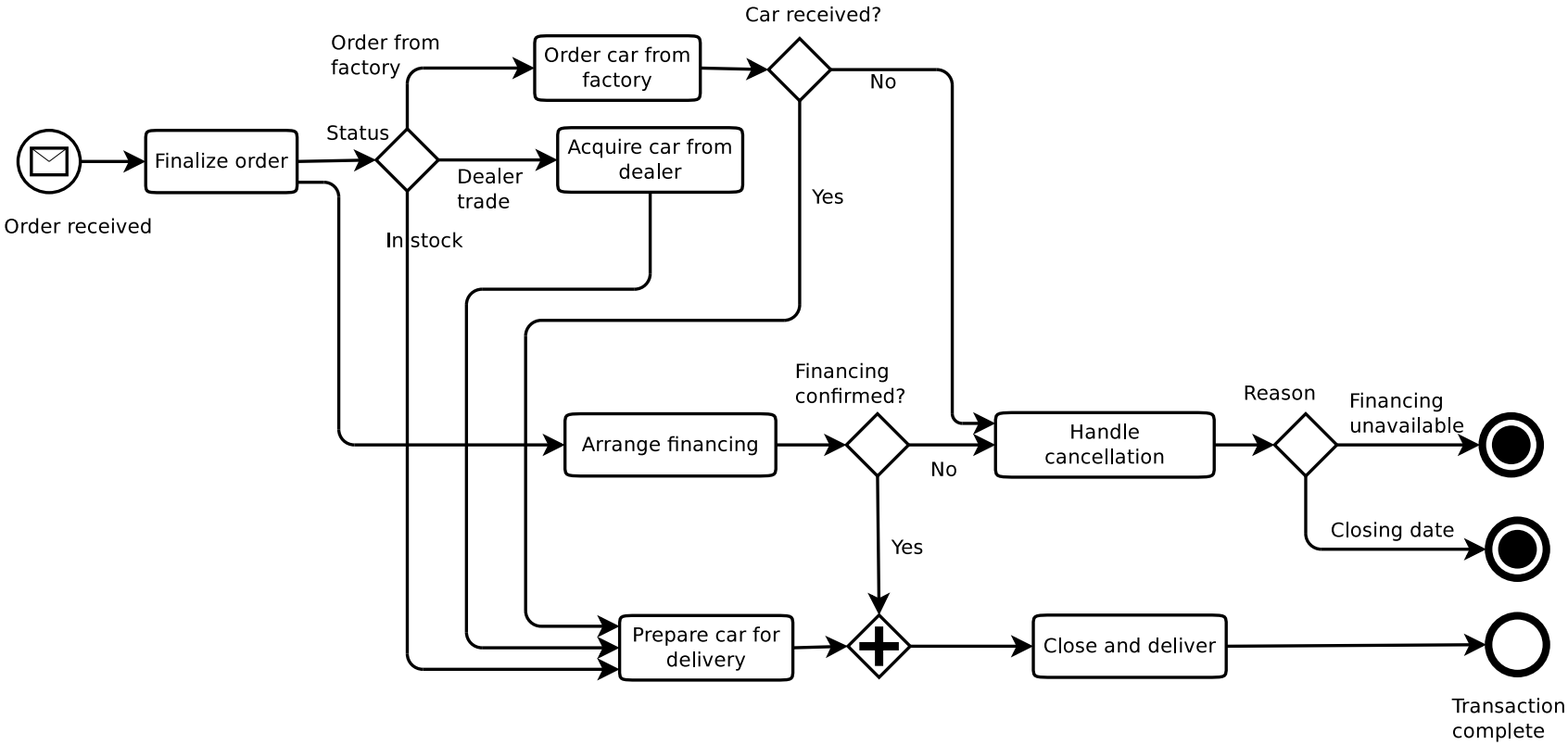


Start with a goal

Make a plan

Execute the plan

My Plans Are Workflows



Institute for Computing and Information Sciences
Radboud University

Actually, Task-Oriented Programs

```
sellCar =
  receiveOrder >>|
  finalizeOrder >>= \status ->
  (acquireCar status -&&- arrangeFinancing) >>|
  closeAndDeliver

acquireCar status =
  case status of
    OrderFromFactory = orderCarFromFactory
    DealerTrade = acquireCarFromDealer
    ReservedFromStock = return ()
  >>| prepareCarForDelivery
```


Institute for Computing
and Information Sciences
Radboud University

During Plan Execution

Everything goes according to plan

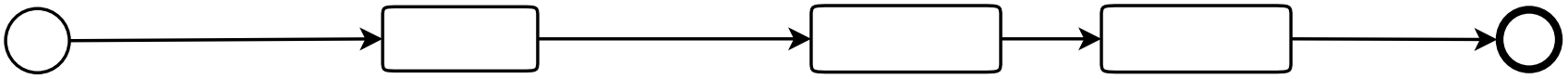
An expected error occurs

An unexpected error occurs

During Plan Execution

Everything goes according to plan	Happy case
An expected error occurs	Sad case
An unexpected error occurs	Unknown case

The Happy Case



Happy Case: Is The Plan Correct?

$$\begin{aligned}\psi(s,a,c,i,t) = {} & s > 0 \implies c \\ & \wedge\, s > 0 \implies a \\ & \wedge\, a \implies (c \wedge t - i < 365) \\ & \wedge\, s \leq 600 \\ & \wedge\, \neg a \implies s \equiv 0\end{aligned}$$

Institute for Computing
and Information Sciences
Radboud University

Happy Case: Is The Plan Correct?

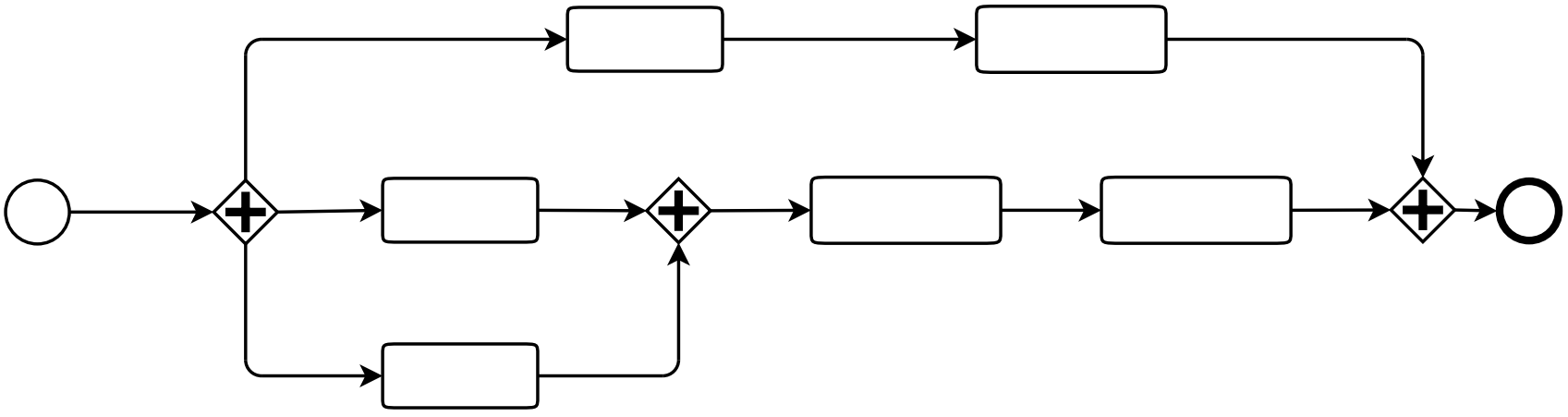
$$\begin{aligned}\psi(s,a,c,i,t) = {} & s > 0 \implies c \\ & \wedge\, s > 0 \implies a \\ & \wedge\, a \implies (c \wedge t - i < 365) \\ & \wedge\, s \leq 600 \\ & \wedge\, \neg a \implies s \equiv 0\end{aligned}$$

Automatically checked

Answer: Yes or No

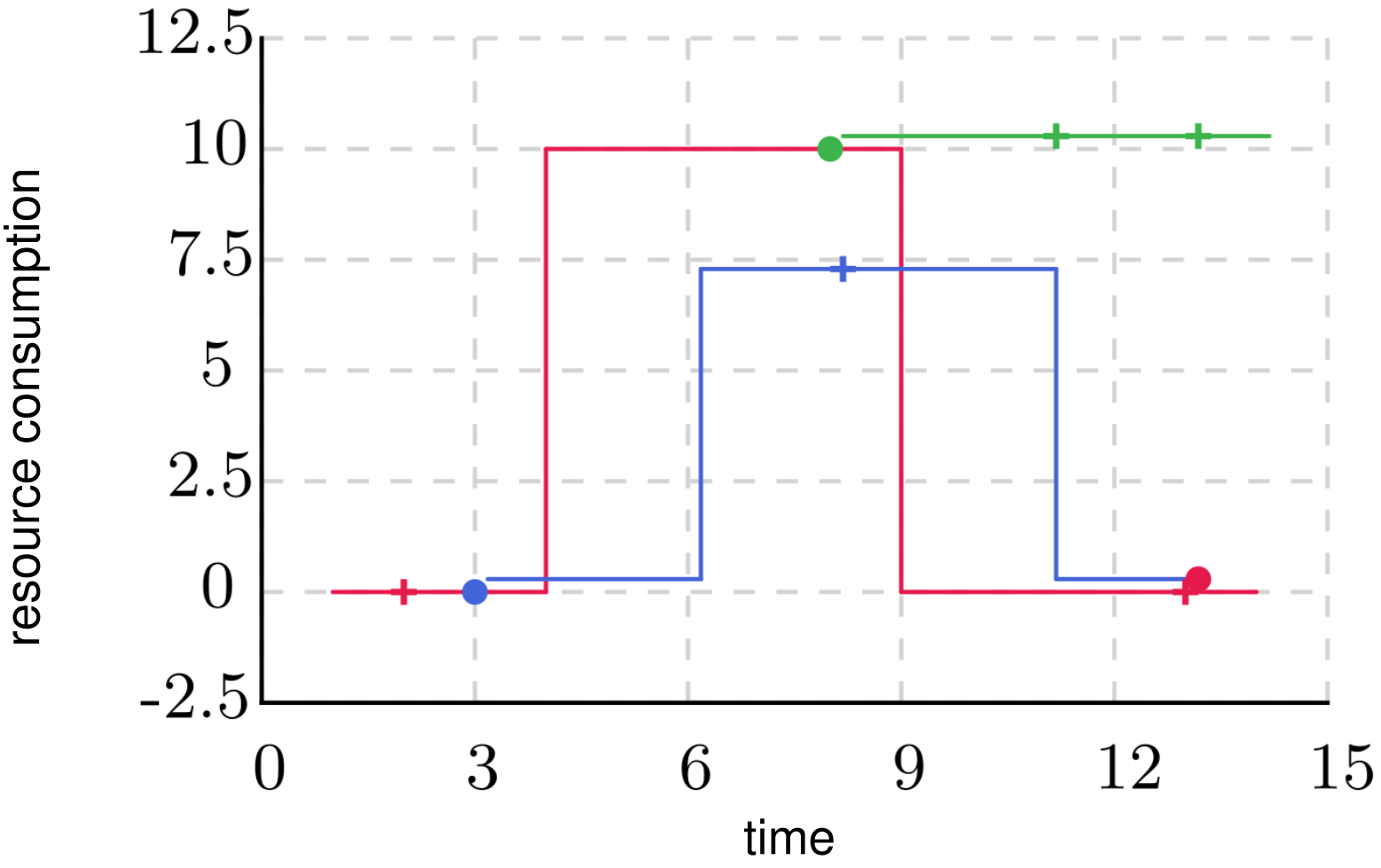
Institute for Computing
and Information Sciences
Radboud University

The Sad Case



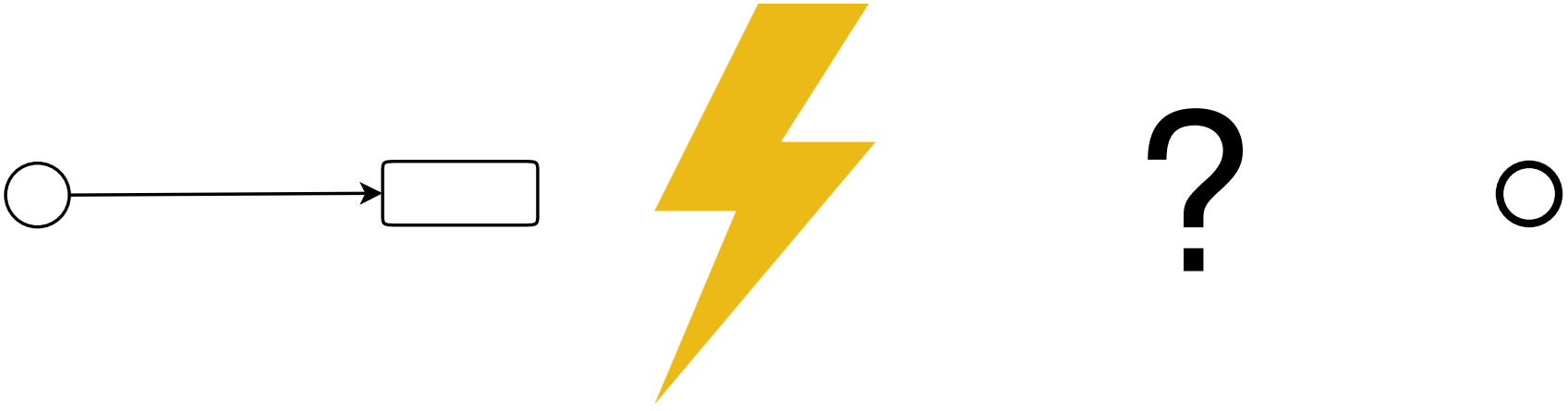
Institute for Computing
and Information Sciences
Radboud University

Sad Case: Do We Have Enough Resources?

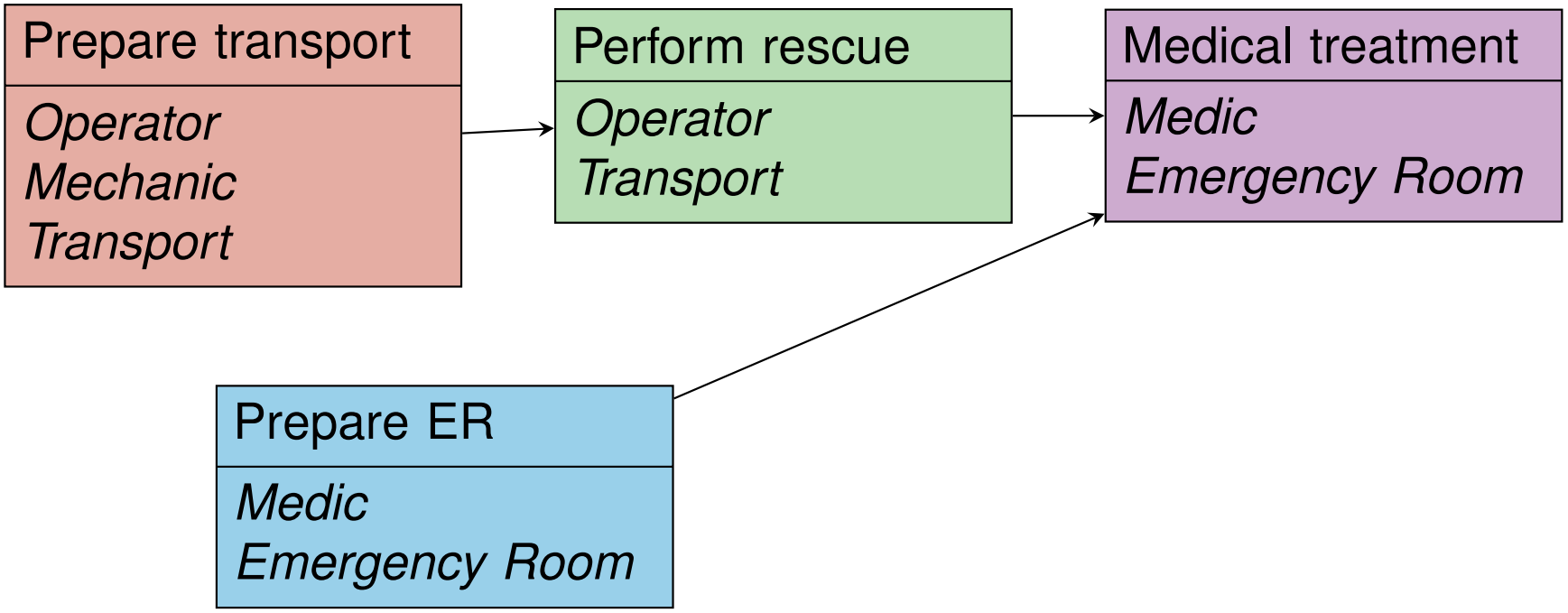


Institute for Computing
and Information Sciences
Radboud University

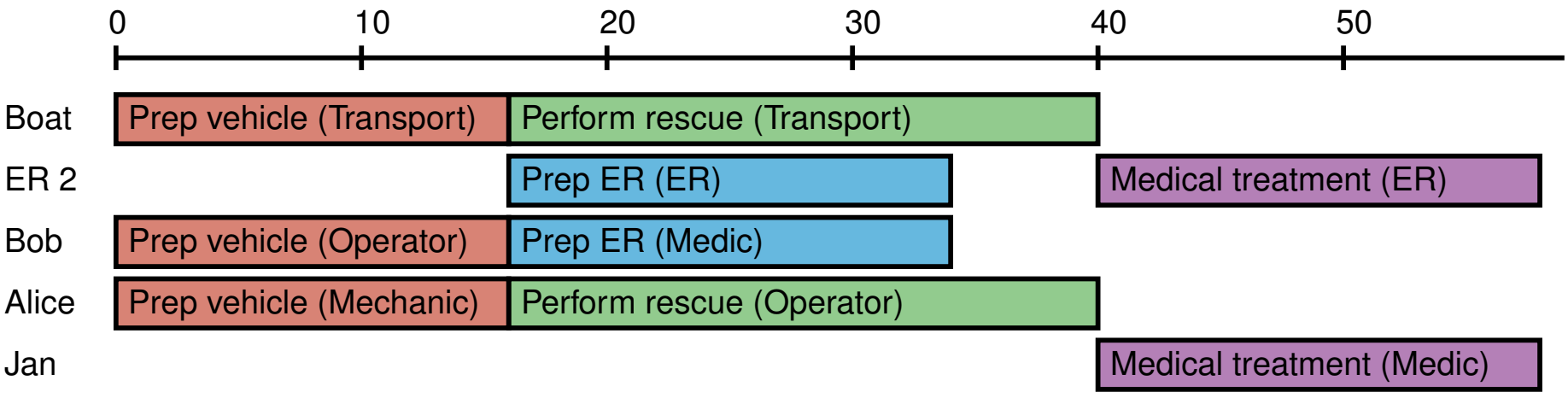
The Unknown Case



The Unknown Case: Repair the Plan



Plan = Assignment + Task Start Times



Institute for Computing
and Information Sciences
Radboud University

Conclusion

Combining TOP and program analysis for workflow analysis

Institute for Computing
and Information Sciences
Radboud University

Conclusion

Combining TOP and program analysis for workflow analysis

Symbolic execution for formal correctness

Institute for Computing
and Information Sciences
Radboud University

Conclusion

Combining TOP and program analysis for workflow analysis

Symbolic execution for formal correctness

Effect systems for resource analysis

Conclusion

Combining TOP and program analysis for workflow analysis

Symbolic execution for formal correctness

Effect systems for resource analysis

Genetic algorithm for automated scheduling

Institute for Computing
and Information Sciences
Radboud University

Attributes

treasure map https://www.freepik.com

lightning
https://www.flaticon.com/authors/smashicons