CSCI427/CSCI927
Service-Oriented Software Engineering

Service/Process Analytics

Process logs

- When a process is executed, it will generate a process log or event log (see an example below)

Check Order for Order No. 4721 completed on 5.12.2017 at 10:11:47

Function StoreCustomerData(Smith, `Railway Pde, Strathfield`) completed on 4.12.2017 at 9:41:24

Forward Order for Order No. 4721 completed on 5.12.2017 at 10:15:18

Function MailCustomerNewsletter(Smith) completed on 4.12.2017 at 9:51:07

Function StoreCustomerData(Lee, `Harbour St., Nowra`) completed on 4.12.2017 at 9:42:08

Check Order for Order No. 4723 completed on 5.12.2017 at 10:21:28

Function MailCustomerNewsletter(Lee) completed on 4.12.2017 at Send 9:53:00

Process logs

- General schema:

<case-ID, task-ID, time-stamp, resource>

- Case-ID: Identifies the process instance (e.g. *Order No*.)
- Task-ID: Identifies the task (e.g., *Check Order*)
- Time-stamp: The date and time
- Resource: The staff member or service worker who completed the task, or the team, or the team plus the machines used

Event logs

- <time-tamp, Event>
- Example: *Approved(InsuranceClaim-447899) at 13:34:23 on 1.12.2017*
- Events are time-stamped records of state changes on business objects of interest
- Process and event logs can be mined in novel ways:
  - Process logs can be extracted from email trails
  - Event logs (for financial or political events) can be extracted from Google News
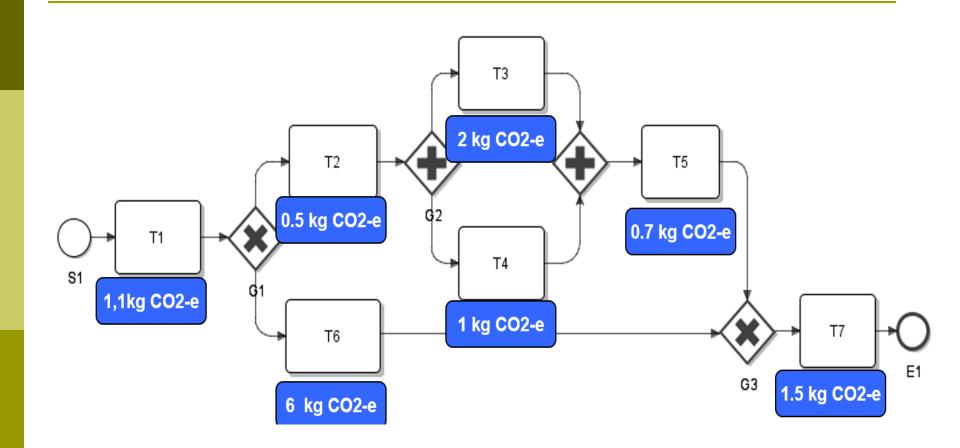
What process mining tells us

- Reverse engineers process models from process execution data
  - actual process execution data (e.g., process/event logs) is analyzed to reconstruct a model
- Holding up a mirror to the organization: *Are we actually doing what we think we're doing?*
- Eases the design acquisition bottleneck
  - Traditional process design requires significant manual effort, involving consultations with stakeholders and experts to create a flowchart.
    - Doctors discuss the necessary medical evaluations.
    - Nurses outline the steps for patient care and monitoring.
    - IT staff describe the electronic health record system's role.
    - Administrators provide insight into insurance and billing procedures.
  - With **process mining** and **data-driven analytics**, process models can be automatically generated from existing execution data.
    - For example, it may highlight that some patients experience delays in discharge due to billing approval, information that may not be fully captured in the traditional manual process.

What process mining tells us

- Enables process improvement:
  - Partition execution histories into **desirable and undesirable instances**
  - Learn only from the "happy" instances
- Offers process **anti-patterns**
  - Mine anti-patterns from the "unhappy" instances

Annotating process models with performance measures

- As a by-product of process mining, we can annotate mined process models with a range of measures:
  - How many **process instances** were executed
  - How many **times** a given flow was taken
  - **Time span** to complete each task and each process instance
  - **Revenue, cost** associated with each flow
  - **Heat-maps** that show bottlenecks in real-time

Some tool vendors

- See an extensive list of process mining tools at
http://www.processmining.org/software.html

- See a demo from one of those tools here
https://www.youtube.com/watch?v=JXW50tq2IPQ
- and here
https://www.youtube.com/watch?v=m2ElXVpTxzQ

- You can use any of those tools for your project.

The Process Analytics Stack

Process analytics is **the mining and analysis of data** generated by, and associated with, the execution of a process.

Predictive Analytics

Diagnostic Analytics

Prescriptive Analytics

Predictive analytics

- Predictive analytics focuses on forecasting future outcomes based on historical data.
  - How long will this process instance take to complete?
  - How much will it cost?
  - What resources will it consume?
  - Will it deliver on the promised functionality (performance)?
  - Will it deliver on the promised KPIs?
  - Can we anticipate problems?

Diagnostic analytics

- Why did this process instance deviate from the flow mandated by the process design?

- Why did this process instance fail to deliver on its promised functionality?

- Why did this process instance violate its KPI guarantees?

Explaining process performance

- *Traditionally:* **Good process designs** led to good performance (hence poor performance → poor process design)

- *Later:* The **quality of the resource** determined the performance of a process (e.g.: an experienced insurance claim handler led to quick claim resolutions)

- *More recently:* **Process context** can be a deciding factor (e.g., the general economic climate can determine how quickly customers settle their insurance claims, *load* on cloud resources)

Prescriptive analytics

Prescriptive analytics goes beyond prediction by providing recommendations for actions or decisions to achieve a desired outcome.

- What should be the next task sequence to execute?
- What resources should we assign to the remaining tasks?
- The current process instance has deviated from the mandated flow, or isn't delivering the expected effects – what is the best fix (*process compensation*) to deploy?

Robotic Process Automation

- RPA can bring greater levels of self-service to field service engagement
- RPA relies on process analytics for:
  - Identifying appropriate deployment points
  - Establishing a KPI baseline to make a business case

With LLMs

- Traditional process mining tools use structured data, but LLMs can improve this by processing unstructured or semi-structured data sources
  - Logs generated by various systems (like CRM, ERP, or healthcare records) can be processed by LLMs to extract patterns of activities
  - Gather customer or employee feedback from various platforms (social media, emails, surveys) and process them through LLMs
  - LLMs can assist in automatically documenting processes by generating standard operating procedures (SOPs) or process descriptions from observed behaviors.

Putting it all together…

- Process and event data is usually routinely available in field service support systems (even if it isn't immediately obvious)
- The value proposition for process analytics is clear
  - Process improvement
  - Efficient resourcing
  - Dynamic adaptation
  - Risk mitigation