Programming by Example

Game Plan

Intention: How to describe a problem?

Multimodal Specifications

- Mathematical Logic
- Examples
- Natural Languages

Invention: How to produce a program?

Synthesis Algorithms

- Deduction
- Enumeration
- Neural Approaches

Adaptation: How to check if the produced program is the desired one?

Interdisciplinary

- Optimization
- Human-Computer Interaction

The Synthesis Conundrum

I don't want to program

The machine should program for me

But I need to tell the machine what I want

I need a notation to describe what I want
with great precision with little room for ambiguity

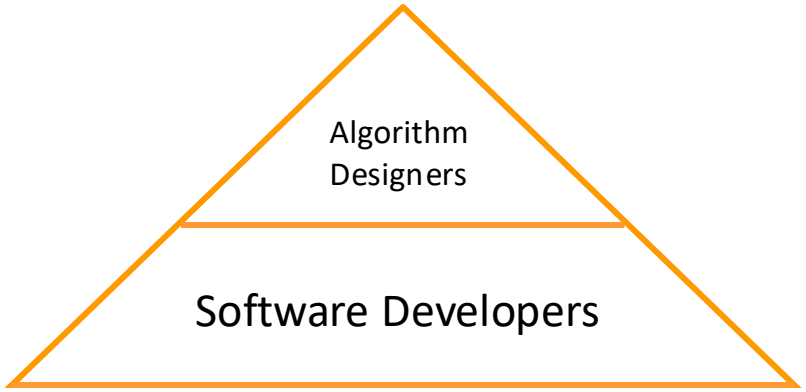
So instead of "programming"

I will write detailed step by step descriptions of system behavior

In a notation that requires great mathematical sophistication

That I have never used before (unlike my favorite programming language which I started using in grade school)

Intention Pillar

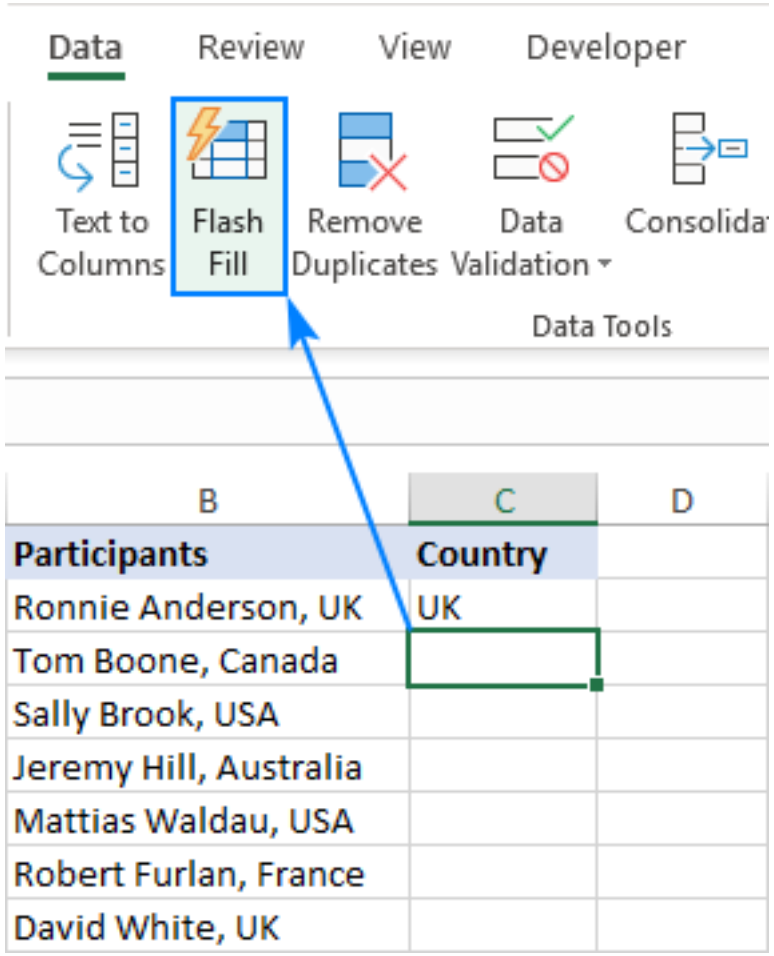


(logics, automata, etc.)

Most Useful Target

(Examples!)

FlashFill: a feature of Excel 2013 (Gulwani et al.)



Demo

PBE vs. Few-Shot Learning

f(“Qiu”, “Xiaokang”)=”XQ”
f(“Purdue”, “John”)=“JP”

f(arg1, arg2)=concat(substring(arg2, 1), substring(arg1, 1))

Examples:
1. "This movie was fantastic! The plot was engaging, and the characters were well-developed." → Positive
2."I hated this film. The acting was terrible, and the storyline was boring." → Negative
3. "An amazing experience! The visuals and music were breathtaking." → Positive

Language Model

"Although the film had some great moments, the pacing was too slow, and I lost interest.”
→ Negative

Variants of PBE

Programming by Demonstration

How it works

- The user ***performs*** the task.
- The system captures key actions and patterns.
- A program is automatically inferred from these demonstrations.

Applications

- Robotics and Automation
- User Interface Design

PBE vs. PBD

Programming by Example (PBE)

- Generally input/output
- E.g., factorial(6) = 720

Programming by Demonstration (PBD)

- In addition to input/output, show a trace of the computation
- E.g., factorial(6) = 6 * (5 * (4 * (3 * (2 * 1)))) = 720
- Pioneered by the Pygmalion system

PBE : PBD = Few-Shot-Learning : Chain-of-Thought

Direct Manipulation

Motivation

- How to apply PBE in graphic design?

How it works

- What you see is what get (WYSIWYG) for graphical user interfaces
- Direct manipulate on the desired output
- Demo: sketch-n-sketch (Chugh et al.)

https://people.cs.uchicago.edu/~brianhempel/sketch-n-sketch-pldi2016-slides.pdf