Data-Driven Programs

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Data-Driven Programs

- In most programming languages, data structures are easier to manipulate than code. As a result, it is often useful to design applications so that as much of their behavior as possible is represented in data rather than in the form of methods. Programs that work this way are said to be ***data-driven***.
- In a data-driven system, the actual program (which is usually called a ***driver***) is generally very small. Such driver programs operate in two phases:
  1. Read data from a file into a suitable internal data structure.
  2. Use the data structure to control the flow of the program.
- To illustrate the idea of a data-driven system, most of this lecture focuses on writing a "teaching machine" of the sort that information technology pioneer and author Ted Nelson discusses (mostly critically) in his book, *Dream Machines*.

The Course Data File

In the teaching machine application, the course designer—who is an expert in the domain of instruction but not likely a programmer—creates a data file that serves as the driver. The general format of the file is shown on the left, and a specific example of a question and its answers appears on the right.

identifying name for the first question
text of the first question

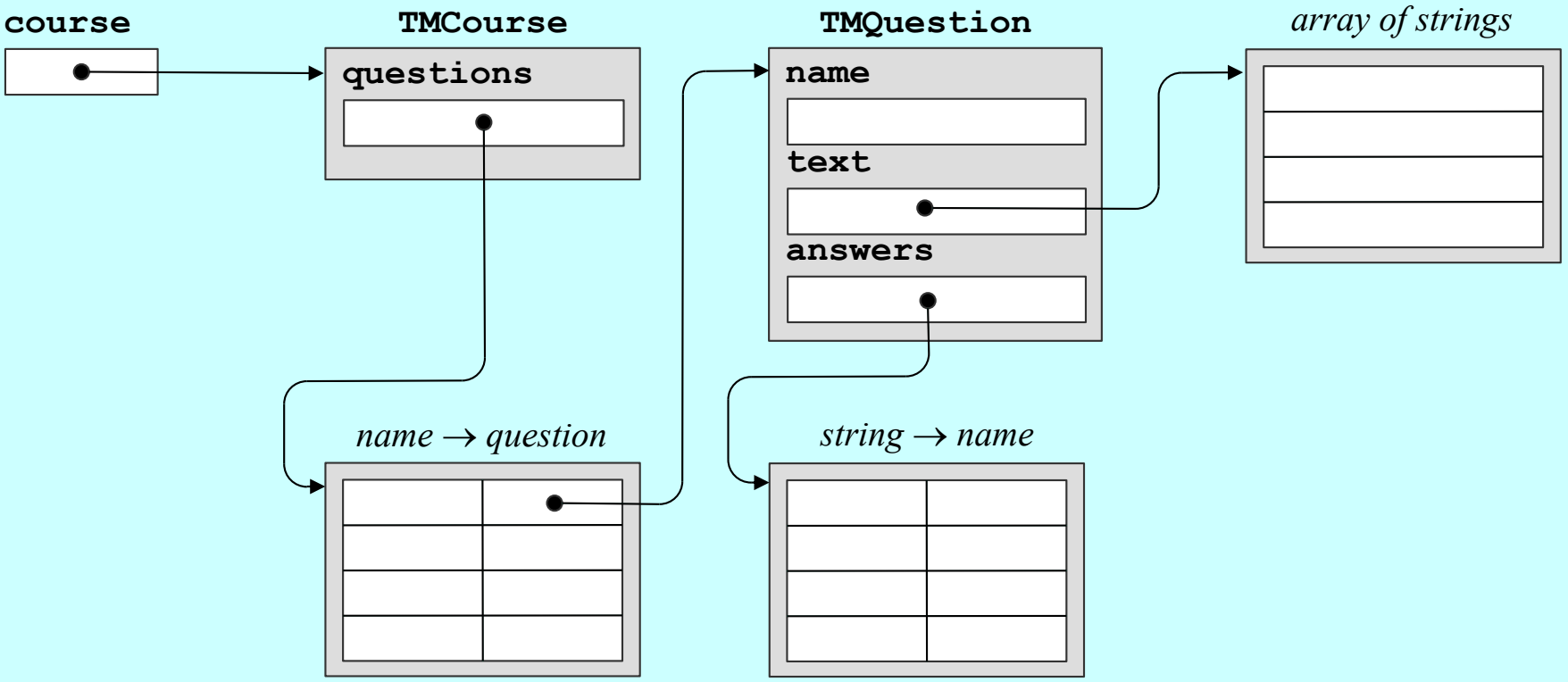
$response_1$ **:** *name of next question*
$response_2$ **:** *name of next question*
$response_3$ **:** *name of next question*
.
.
.

. . . other question/answer entries . . .

```
RemQ1
What is the value of 17 % 4?
   a. 0
   b. 1
   c. 3
   d. 4
-----
a: RemQ2
0: RemQ2
b: PrecQ1
1: PrecQ1
c: RemQ2
3: RemQ2
d: RemQ2
4: RemQ2
```

Choosing an Internal Representation

The first step in building the teaching machine is to design a set of classes that can represent the data and their relationships in the file. All relevant data should be accessible from a single structure that contains all relevant information in a nested series of classes.



Converting External to Internal Form

```
DivQ1
What is the value of 3 / 2?
-----
1: DivQ2
1.5: DivQ4
*: DivQ3

DivQ2
The / operator produces floats.
What is the value of 9 / 3?
-----
3: DivQ2
3.0: DivQ4
*: DivQ3

DivQ3
What is the value of 5 / 4?
-----
1.25: DivQ4
*: DivQ2

DivQ4
What is the value of 9 // 4?
-----
2: EXIT
*: DivQ1
```

The `TeachingMachine` Program

```
# File: TeachingMachine.py

from TMCourse import TMCourse

def TeachingMachine():
    course = readCourseFile()
    course.run()

def readCourseFile():
    while True:
        try:
            filename = input("Enter course name: ")
            with open(filename + ".txt") as f:
                return TMCourse.readCourse(f)
        except IOError:
            print("Please enter a valid course name.")

# Startup code

if __name__ == "__main__":
    TeachingMachine()
```

The `TMCourse` Class

```
# File: TMCourse.py

from TMQuestion import TMQuestion

class TMCourse:

    def __init__(self, questions):
        self._questions = questions

    def run(self):
        current = "START"
        while current != "EXIT":
            question = self._questions[current]
            for line in question.getText():
                print(line)
            answer = input("> ").strip().upper()
            next = question.lookupAnswer(answer)
            if next is None:
                print("I don't understand that response.")
            else:
                current = next
```

The `TMCourse` Class

```
# Implementation notes
# --------------------
# To make sure that the course starts at the first
# question, this method always includes an entry
# labeled "START" in the question table.

    @staticmethod
    def readCourse(f):
        questions = { }
        while True:
            question = TMQuestion.readQuestion(f)
            if question is None: break
            if len(questions) == 0:
                questions["START"] = question
            name = question.getName()
            questions[name] = question
        return TMCourse(questions)
```

The `TMQuestion` Class

```
# File: TMQuestion.py

MARKER = "-----"

class TMQuestion:
    def __init__(self, name, text, answers):
        self._name = name
        self._text = text
        self._answers = answers

    def getName(self):
        return self._name

    def getText(self):
        return self._text

    def lookupAnswer(self, response):
        next = self._answers.get(response, None)
        if next is None:
            next = self._answers.get("*", None)
        return next
```

The `TMQuestion` Class

```
@staticmethod
def readQuestion(f):
    name = f.readline().rstrip()
    if name == "":
        return None
    text = [ ]
    while True:
        line = f.readline().rstrip()
        if line == MARKER: break
        text.append(line)
    answers = { }
    while True:
        line = f.readline().rstrip()
        if line == "": break
        colon = line.find(":")
        if colon == -1:
            raise ValueError("Missing colon in " + line)
        response = line[:colon].strip().upper()
        next = line[colon + 1:].strip()
        answers[response] = next
    return TMQuestion(name, text, answers)
```

The End