

# 1. Data Structures

## People

You are to write a program which works with a collection of people. We are interested in name and age only of each person. What data structure would use to represent the collection?

## RoomsInABuilding

The Sir Alwyn Williams Building has 5 floors. There are a number of rooms on each floor. Each room has a number, a capacity, whether it has a window, and whether or not it has a data projector in it. What data structure could hold this information?

## PhoneContactsList

In this exercise, we'll consider how contacts are stored on your mobile phone. We'd like to be able to find/lookup any phone numbers using the name of the person we'd like to call.

1. Consider the simplest case of a structure that can hold a single entry consisting of the persons name and an associated phone number. What data structure could you use to store the following entry 'Mick Jagger' with telephone number 07731 423321?
2. For the phone numbers we'd like replace the single value with a more complex set of information which includes the type of phone: work, home, mobile, the number associated with it and the type of phone that is the default number for this contact. How would you adjust your data structure to include this additional information? For 'Mick Jagger' 07731 423321 is his mobile number and his home phone is 0112 337 8932. Mick is abroad a lot so his default number should be his mobile phone.
3. We have the structure for one contact but most people have more than one friend or family member they'd like to call. How would you extend your data structure to add a new entry for 'Keith Richards', mobile number 07832 778412, home phone 0133 227 3345 and default number home phone?
4. Declare and initialise a variable called **contacts** to store the two contacts and then write code to lookup up and print the following values:
  - a. Mick Jagger's mobile number
  - b. Keith Richard's home phone
  - c. Mick Jagger's default number

## Music

A program is needed that works with music. We need a data structure to hold a tune. Let's consider what's in a tune?

- It consists of a sequence of notes played one at a time - one after the other.
  - Each note has a pitch - how high or low the note sounds - and we will assume this is one of 56 notes.
    - These notes are divided into 8 octaves, numbered 1 to 8.
    - Each octave has 7 notes in sequence, letter A to G.
  - A note may be a semi-tone higher (sharp) or a semi-tone lower (flat) or natural.
  - A note has a duration - how long it is played for.
    - This is measured in beats -  $1/16$ ,  $1/8$ ,  $1/4$ ,  $1/2$ , 1, 2, 4
    - A note can be "dotted", which increases the duration by half its main duration
1. Come up with a suitable Python data structure to hold a single note.
  2. Extend this to hold a complete tune as described above.
  3. How would you extend your data structure to include *chords* - multiple notes played at the same time?

## TextDocument

In this exercise, we'll consider how documents are represented as a data structure.

1. Consider a plain text document as an ordered collection of paragraphs. What data structure would you use to hold it?
2. Now imagine that each paragraph can have styling attached - for this example, consider only the styling bold, italics, underline, which can be applied in any order. Adjust/extend your data structure as necessary.
3. Now, individual sequences of characters within the text can be styled, using the same three options as in (2) above. Extend your data structure further.
4. Finally, how would you extend your data structure to enable the document to contain images inserted at arbitrary points in the text. For this example, it doesn't matter exactly how an image is represented - say it's an empty dictionary for now; the challenge is to work out how to mix text and images.