### Activity 1

**Introduction**

T: Does anyone know anything about ASCII computer codes?

T: They are used by computers to represent letters, numbers, etc. Look at this sheet – what do you notice?

(Each character uses 7 'bits' of 0 or 1)

T: That's right. How many different characters can be coded with this system?

(2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^7 = 128)

T: Is this an efficient way to transmit messages/data, etc?

T: Can you think of a better way?

(Use shorter codes for letters which occur more frequently)

T: This is the basis of Huffman codes.

### Huffman code

T: We'll look at how this works when we use just 5 letters

- E  A  M  N  T

which are given in decreasing order of frequency of use.

T: We use a tree diagram to illustrate the code, with '0' to the right of the branches and '1' to the left – look at the diagram.

T: How many codes are there?

(5)

T: What are the codes?

(1, 00, 010, 0110, 0111)

T: How do you think we allocate these?

(Shortest code for the letter with the highest frequency, etc.)

T: OK. Who can complete the table?

<table>
<thead>
<tr>
<th>P (on board):</th>
<th>Code</th>
<th>Letter</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>E</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>010</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0110</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0111</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

T: Now that we have the codes, we can decode

\[0111000101010000110\]

T: Now work in pairs to decode

\[0100001100001110111100\]

T: What did you get?

Well done.

### Other Huffman codes

T: Are other possible Huffman codes that we could use?

Ps' ideas should be used whenever possible here, but T will need to ensure that they produce a sensible Huffman code.

Volunteer P, at board, completes the table. Other Ps watch and agree/disagree.

T praises if correct.

T shows code on board and Ps identify letters.

Ps work in pairs for a few minutes to decode; T monitors progress. Interactive review of answers.

Whole class discussion of possible codes for 5 letters. T should give Ps sufficient time to

### Notes

T: Teacher  P: Pupil  Ex.B: Exercise Book

T builds on Ps' knowledge of computer codes, if possible.

OS 17.1 is shown, or Ps are each given a copy.

T introduces, interactively, the concept of compressing data, etc. for internet transmission.
### Codes and Ciphers

<table>
<thead>
<tr>
<th>UNIT 17 Huffman Codes</th>
<th>Lesson Plan 1</th>
</tr>
</thead>
</table>

#### Activity 3

T: So we have three possible solutions. Which one should we use? *(Depends on letter frequencies)*

T: Absolutely! When should we use

![Diagram](image)

*(When 3 letters have similar but higher frequency than the other 2)*

and this?

![Diagram](image)

*(When one letter is used much more than the other 4)*

35 mins

#### Activity 4

T: Look at Activity 2 in the *Pupil Text*. Start with part a) and see how you get on. You can work with the person next to you for this.

T: Who would like to give us an answer? Come and write one of your codes on the board.

T: Does everyone agree that this is correct? Who would like to give us another code?

45 mins

#### Homework

Complete Activity 2, part b).

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**Notes**

- Think of all the possibilities. Ps display their suggestions. T can show OS 17.3 if Ps do not suggest all these possibilities.

- T should try to get Ps to deduce the answers for themselves. The concept of length × frequency can also be used (see *Pupil Text*) to make this more precise.

- Ps work in pairs; T monitors work carefully to make sure that Ps have understood the concept and the problem.

- Review of part a) before Ps move on to part b).