1. A small Matter of Programming

(a) function countdown(n) {
    i = n
    while ( i >= 1) {
        print n
        i = i - 1
    }
    print "Done!"
}

(b) n = 0; b = 0
while (n <= 10) {
    b = b + Math.pow(2, n)
    n = n + 1
}
print b

2. File Systems

(a) Note that there are multiple files with the same name. They are different files as they are in different directories.

<table>
<thead>
<tr>
<th></th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>F1</th>
<th>F2</th>
<th>D3</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D6</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F6</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

So we need 26 blocks.

(b) We only need to load the first block of D1 to find F1. So we need 1+3=4 blocks.
(c) We only need to load the first block of D1 to find F4. In all, we need 1+1+1+2=5 blocks.

(d) *D1 will only be read once.
   Option 1. We can determine from information at D1 that the files are of different sizes and so different. So we need to read 2 blocks.
   Option 2. To read all the blocks of F1 and F2, we need 2+3+2=7 blocks.
   Option 3. We can determine from the first two blocks of F1 and F2 that they are different. So we need to read 2+2+2=6 blocks.

(e) We just need to read the first block of D1 and D2, which is 1+1=2 blocks.

(f) F5

(g) F1

3. Yet More Numbers

(a) (i) \( \log_2 \frac{1.7 \times 10^6}{9000} \approx 10.88 \). The double period is \( \frac{2015−1975}{10.88} \approx 3.68 \) years. Longer.
   (ii) \( \log_2 \frac{4.3 \times 10^6}{2700} \approx 10.64 \). The double period is \( \frac{2014−1972}{10.64} \approx 3.95 \) years. Longer.
   (iii) \( \log_2 \frac{17.3 \times 10^6}{3.4 \times 10^6} \approx 2.35 \). The double period is \( \frac{2015−2008}{2.35} \approx 2.98 \) years. Longer.
   (iv) \( \log_2 \frac{5 \times 10^7}{5 \times 10^6} \approx 3.32 \). The double period is \( \frac{2007−1993}{3.32} \approx 4.22 \) years. Longer.

(b) (i) Total contribution is \((0.26 + 0.22) \times (5.2 \times 10^8) \approx 250 \) million.
   (ii) By some calculations, we can see that Services, Manufacturing and Other contribute more than \$60 \) million in both 1988 and 1991.
   (iii) Manufacturing Sector's Decrease is \( 630 \times 0.31 – 520 \times 0.2 = 91 \) million. Retail's Decrease is \( 630 \times 0.19 – 520 \times 0.08 \approx 78 \) million. So Manufacturing decreased by the greatest amount.
   (iv) The amount is \((0.5 \times 0.75 \times 0.08 \times −0.25 \times 0.08) \times 5.2 \times 10^8 = 5.2 \) million.

(c) (i) The rate is

\[
R = 200 \text{cables} \times 10 \text{Gbps} \times \frac{10^{-8} \text{petabyte}}{1 \text{gigabyte}} \times \frac{1 \text{byte}}{8 \text{bits}} \times \frac{3600 \text{seconds}}{\text{hour}} \times \frac{24 \text{hours}}{\text{day}},
\]

which is 21.6 petabyte per day.

(ii) We assume that one book has 100 thousand words, each word is 5 characters and every character is encoded into 1 byte. Therefore, each book requires 0.5MB. So the number of books is around

\[
21.6 \times 10^{15} \times \frac{1}{192} \times \frac{1}{0.5 \times 10^6} \approx 225 \text{ million} \quad (0.1)
\]