# Homework 8 Answer

## 1.

(a) T
(b) F
(c) T
(d) F
(e) T

---

## 2. MapReduce

### 2.1 Map Phase Output

(/home, 1), (/products, 1), (/home, 1), (/products, 1), (/contact, 1), (/about, 1)

### 2.2 Shuffle Phase Aggregation

/home : [1, 1]
/products : [1, 1]
/contact : [1]
/about : [1]

### 2.3 Reduce Phase Output and Top-2 URLs

/home : 2
/products : 2
/contact : 1
/about : 1

Top-2 most visited URLs: /home, /products

---

## 3. ECC

### 3.1 Insert parity bits

Value: 1 0 0 1 1 1 0 0 0 1 0 1
Type(P/D): P P D P D D D P D D D D

12-bit codeword: 100111000101

### 3.2 ECC coverage table

| Bit Position | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| p1 covers | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | | ✓ | |
| p2 covers | | ✓ | ✓ | | | ✓ | ✓ | | | ✓ | ✓ | |
| p4 covers | | | | ✓ | ✓ | ✓ | ✓ | | | | | ✓ |

| Bit Position | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| p8 covers | | | | | | | | ✓ | ✓ | ✓ | ✓ | ✓ |

## 3.3 Single-bit error detection and correction

Received codeword: 1 0 0 1 1 1 0 0 0 1 1 1

| Bit check | Result |
|---|---|
| Bit 1 check | X |
| Bit 2 check | X |
| Bit 4 check | ✓ |
| Bit 8 check | X |

Error bit position: 11

Corrected codeword: 1 0 0 1 1 1 0 0 0 1 0 1

## 3.4 Double-bit error

Received codeword: 1 0 1 1 1 1 0 0 0 1 1 1

| Bit check | Result |
|---|---|
| Bit 1 check | ✓ |
| Bit 2 check | ✓ |
| Bit 4 check | ✓ |
| Bit 8 check | X |

Can we determine which bit(s) are wrong?

No. With only the four Hamming parity bits, the syndrome can indicate a nonzero error pattern, but it cannot uniquely identify two erroneous bits. Therefore, the wrong bit(s) cannot be determined reliably.