1. For each of the statement below, indicate whether the statement is true [T] or false [F].

a. Finding a feasible path between two points in a complicated map is a class NP problem.

b. During initialization of a GA, the population diversity tends to be the highest.

c. Selection of parents reduces population diversity while recombination increases diversity.

d. A GA is used to solve for the weight matrix of an artificial neural network. This indeed is a simulation problem according to the black box problem characterization.

e. An example of class P problem is one of finding a solution to a N-queens problem.

f. For a GA that uses binary tree structure representation, the Boolean expression F=abcdef should have 12 edges.

g. It is still possible for an evolutionary algorithm to work, with only recombination.

h. NP stands for non-distinguishable polynomial.

i. Recombination increases population diversity while mutation reduces diversity.

j. It is possible to show that P=NP if we have enough computing resources at our disposal.

2. For a permutation string coded GA, the selected parents for recombination are `<abcdefghij>` and `<jaibhcgdfe>`.

Perform order one crossover operation on the **shaded substrings (positions 4–8)** and write the two offspring.

```
1   Parent 1: a b c [d e f g h] i j
2   Parent 2: j a i [b h c g d] f e
```

3. For a permutation string coded GA, the selected parents for recombination are `<abcdefghij>` and `<jaibhcgdfe>`.

Perform partially matched crossover operation on the **shaded substrings (positions 4–8)** and write the two offspring.

```
1   Parent 1: a b c [d e f g h] i j
2   Parent 2: j a i [b h c g d] f e
```

4. For a permutation string coded GA, the selected parents for recombination are `<abcdefghij>` and `<jaibhcgdfe>`.

Perform cycle crossover operation on the **shaded substrings (positions 4–8)** and write the two offspring.

```
1  Parent 1: a b c [d e f g h] i j
2  Parent 2: j a i [b h c g d] f e
```

5. A common approach to select parents for crossover is the fitness proportional selection.

Discuss on the effectiveness of the approach at different stages of a GA search.

1. 对于以下每个陈述，判断其为真 [T] 或假 [F]。

a. 在复杂地图中找到两点之间的可行路径是一个 NP 类问题。

b. 在遗传算法初始化过程中，种群多样性往往最高。

c. 父代选择会降低种群多样性，而重组会增加多样性。

d. 遗传算法用于求解人工神经网络的权重矩阵。这确实是基于黑箱问题刻画的一个仿真问题。

e. P 类问题的一个例子是寻找 N 皇后问题的解。

f. 对于使用二叉树结构表示的遗传算法，布尔表达式 F=abcdef 应有 12 条边。

g. 即使只有重组，进化算法仍有可能工作。

h. NP 表示不可区分多项式。

i. 重组增加种群多样性，而变异减少多样性。

j. 如果有足够的计算资源，我们可以证明 P=NP。

2. 对于一个排列字符串编码的遗传算法，选择的父代为 `<abcdefghij>` 和 `<jaibhcgdfe>`。

请在 **阴影部分（第 4–8 位）** 执行 **顺序一交叉（order one crossover）** 操作，并写出两个子代。

```
1  父代 1：a b c [d e f g h] i j
2  父代 2：j a i [b h c g d] f e
```

3. 对于一个排列字符串编码的遗传算法，选择的父代为 `<abcdefghij>` 和 `<jaibhcgdfe>`。

请在 **阴影部分（第 4–8 位）** 执行 **部分匹配交叉（partially matched crossover, PMX）** 操作，并写出两个子代。

```
1   父代 1：a b c [d e f g h] i j
2   父代 2：j a i [b h c g d] f e
```

4. 对于一个排列字符串编码的遗传算法，选择的父代为 `<abcdefghij>` 和 `<jaibhcgdfe>`。

请在 阴影部分（第 4–8 位） 执行 循环交叉（**cycle crossover**） 操作，并写出两个子代。

```
1   父代 1：a b c [d e f g h] i j
2   父代 2：j a i [b h c g d] f e
```

5. 选择父代进行交叉的常见方法是 适应度比例选择。

请讨论这种方法在遗传算法搜索不同阶段的有效性。