Учреждение образования

«Белорусский государственный технологический университет»

**Математическое программирование**

**Лабораторная работа №5**

**АЛГОРИТМЫ НА ГРАФАХ**

**(алгоритмы поиска в ширину и глубину, топологическая сортировка)**

Выполнил:

Студентка 2 курса 7 группы ФИТ

Колядко Яна Дмитриевна

**ЦЕЛЬ РАБОТЫ:** освоить сущность и программную реализацию: а) способов представления графов; б) алгоритмов поиска в ширину и глубину; в) алгоритма топологической сортировки графов.

**Задание 1.**  Ориентированный граф **G** взять в соответствии с вариантом. Осуществить алгоритмы поиска в ширину и глубину, а также алгоритма топологической сортировки аналогично примерам, рассмотренным на лекциях. Оформить отчет, включив в него **каждый** шаг выполнения алгоритмов.

|  |  |
| --- | --- |
| 6 | Изображение выглядит как текст, часы  Автоматически созданное описание |

**Поиск в ширину**

**Изображение выглядит как текст, часы

Автоматически созданное описание**

Q

|  |
| --- |
| 0 |

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | W | W | W | W | W | W |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| O | I | I | I | I | I | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | N | N | N | N | N | N |

Изображение выглядит как текст, часы

Автоматически созданное описание

Q

|  |  |  |
| --- | --- | --- |
| 1 | 2 | 3 |

C

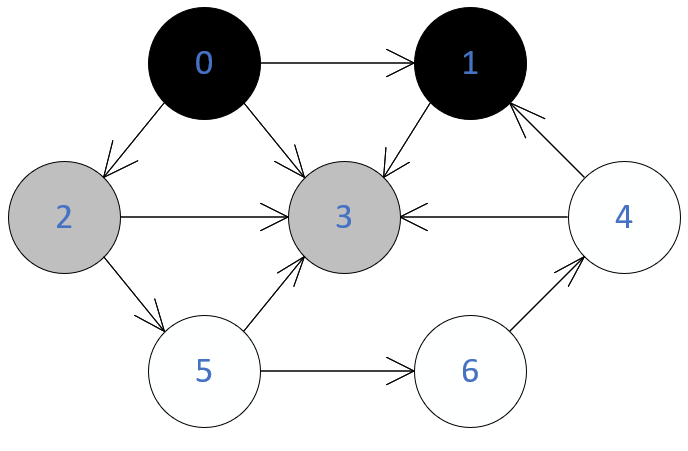
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| B | G | G | G | W | W | W |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| O | 1 | 1 | 1 | I | I | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 0 | N | N | N |



Q

|  |  |
| --- | --- |
| 2 | 3 |

C

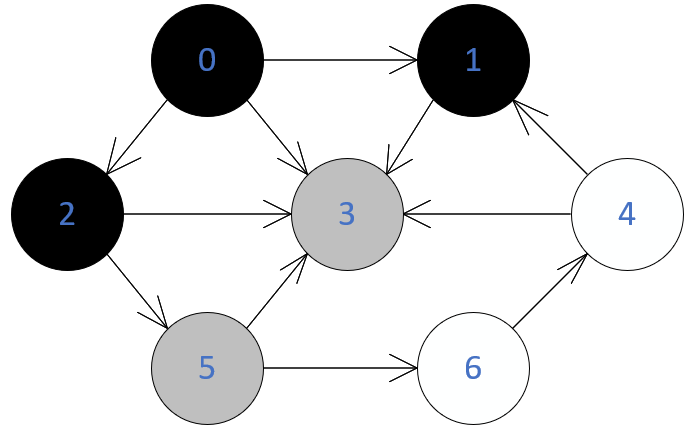
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| B | B | G | G | W | W | W |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| O | 1 | 1 | 1 | I | I | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 0 | N | N | N |



Q

|  |  |
| --- | --- |
| 3 | 5 |

C

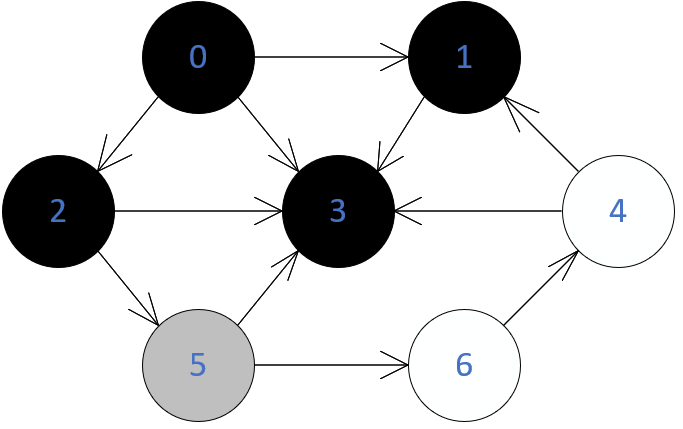
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| B | B | B | G | G | W | W |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| O | 1 | 1 | 1 | 2 | I | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 0 | 2 | N | N |



Q

|  |
| --- |
| 5 |

C

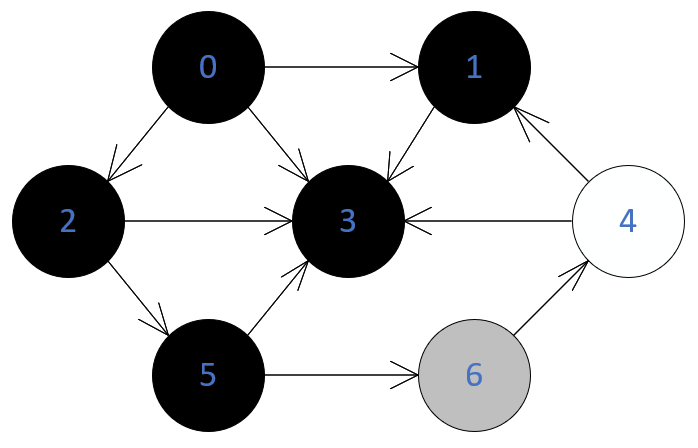
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| B | B | B | B | W | G | W |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| O | 1 | 1 | 1 | 2 | I | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 0 | 2 | N | N |



Q

|  |
| --- |
| 6 |

C

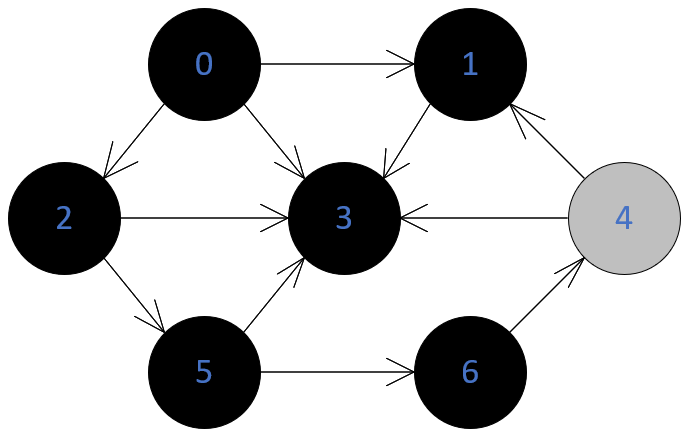
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| B | B | B | B | W | B | G |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| O | 1 | 1 | 1 | I | 2 | 3 |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 0 | I | 2 | 5 |



Q

|  |
| --- |
| 4 |

C

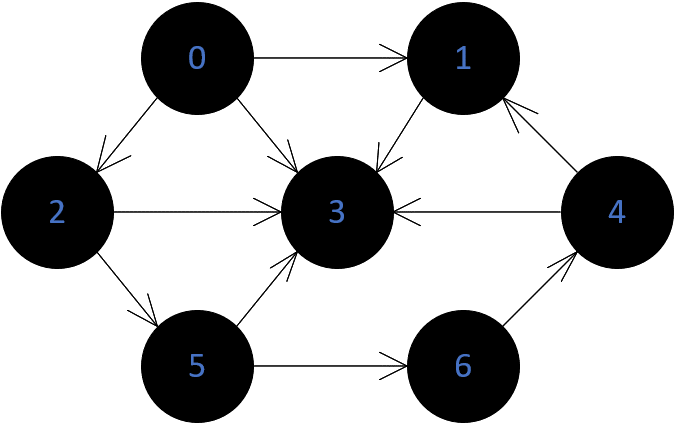
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| B | B | B | B | G | B | B |

D

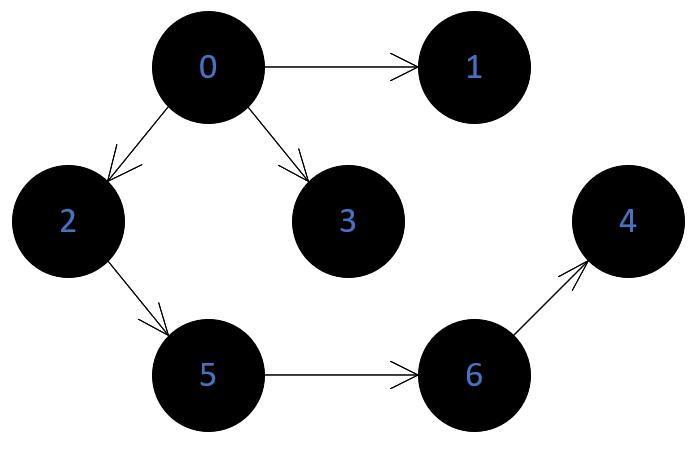
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| O | 1 | 1 | 1 | 4 | 2 | 3 |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 0 | 6 | 2 | 5 |



BFS-дерево:



**Поиск в глубину**

Изображение выглядит как текст, часы

Автоматически созданное описание

t=1

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | W | W | W | W | W | W |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | I | I | I | I | I | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | I | I | I | I | I | I |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | I | I | I | I | I | I |

Изображение выглядит как текст, часы

Автоматически созданное описание

t=2

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | G | W | W | W | W | W |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | I | I | I | I | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | I | I | I | I | I | I |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | I | I | I | I | I | I |

Изображение выглядит как часы

Автоматически созданное описание

t=3

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | G | W | G | W | W | W |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | I | 3 | I | I | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | I | 1 | I | I | I |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | I | I | I | I | I | I |

Изображение выглядит как текст, небо, часы

Автоматически созданное описание

t=4

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | G | W | B | W | W | W |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | I | 3 | I | I | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | I | 1 | I | I | I |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | I | I | 4 | I | I | I |

Изображение выглядит как текст, небо, часы

Автоматически созданное описание

t=5

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | B | W | B | W | W | W |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | I | 3 | I | I | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | I | 1 | I | I | I |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | 5 | I | 4 | I | I | I |

Изображение выглядит как текст, часы

Автоматически созданное описание

t=6

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | B | G | B | W | W | W |

D

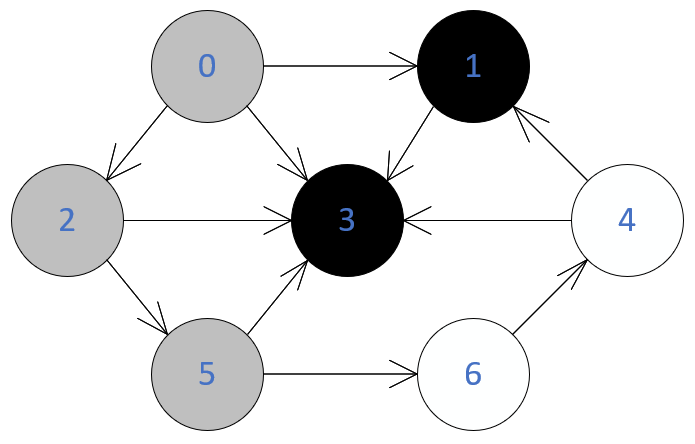
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 6 | 3 | I | I | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 1 | I | I | I |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | 5 | I | 4 | I | I | I |



t=7

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | B | G | B | W | G | W |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 6 | 3 | I | 7 | I |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 1 | I | 2 | I |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | 5 | I | 4 | I | I | I |

Изображение выглядит как текст, часы

Автоматически созданное описание

t=8

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | B | G | B | W | G | G |

D

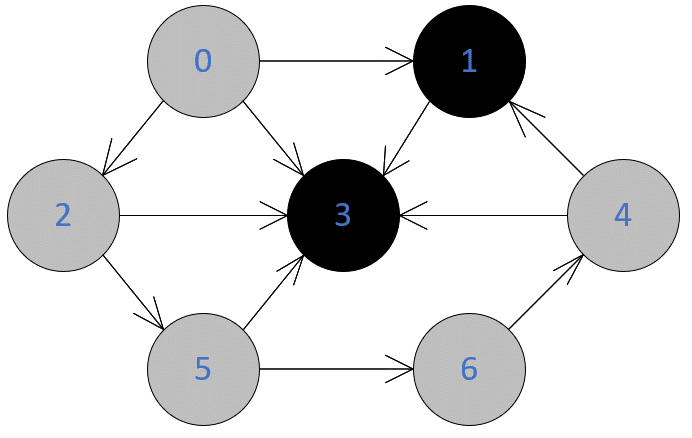
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 6 | 3 | I | 7 | 8 |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 1 | I | 2 | 5 |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | 5 | I | 4 | I | I | I |



t=9

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | B | G | B | G | G | G |

D

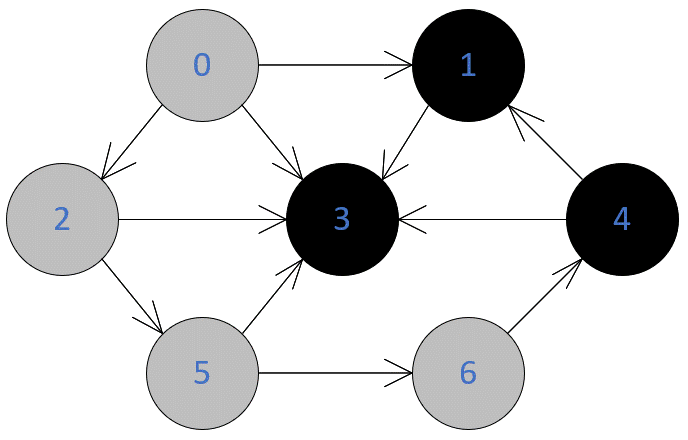
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 6 | 3 | 9 | 7 | 8 |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 1 | 6 | 2 | 5 |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | 5 | I | 4 | I | I | I |



t=10

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | B | G | B | B | G | G |

D

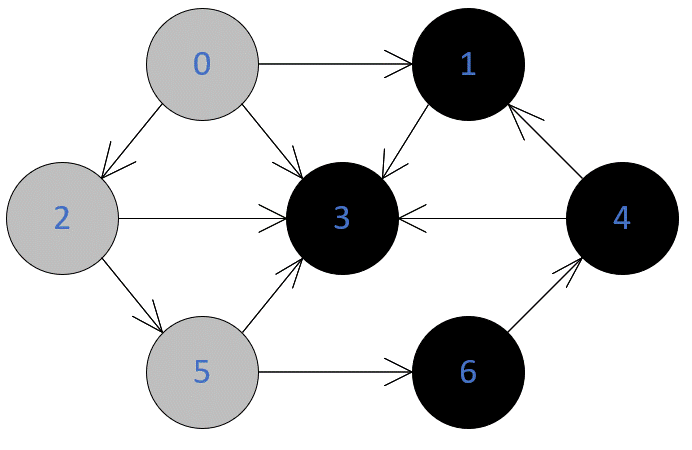
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 6 | 3 | 9 | 7 | 8 |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 1 | 6 | 2 | 5 |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | 5 | I | 4 | 10 | I | I |



t=11

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | B | G | B | B | G | B |

D

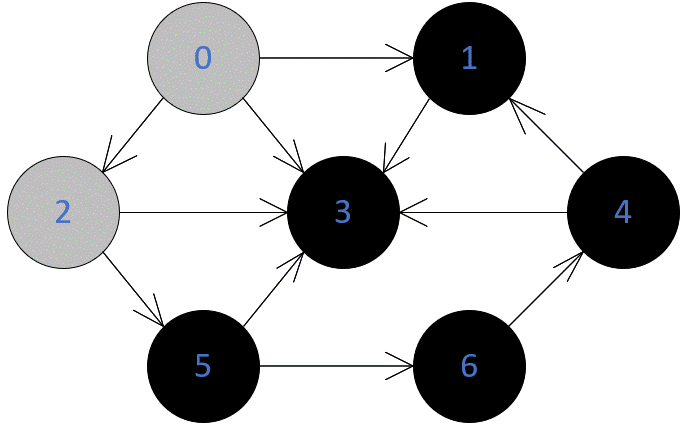
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 6 | 3 | 9 | 7 | 8 |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 1 | 6 | 2 | 5 |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | 5 | I | 4 | 10 | I | 11 |



t=12

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | B | G | B | B | B | B |

D

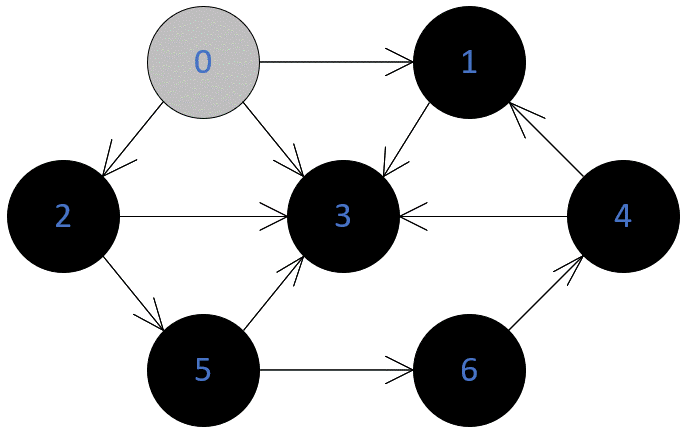
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 6 | 3 | 9 | 7 | 8 |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 1 | 6 | 2 | 5 |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | 5 | I | 4 | 10 | 12 | 11 |



t=13

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| G | B | B | B | B | B | B |

D

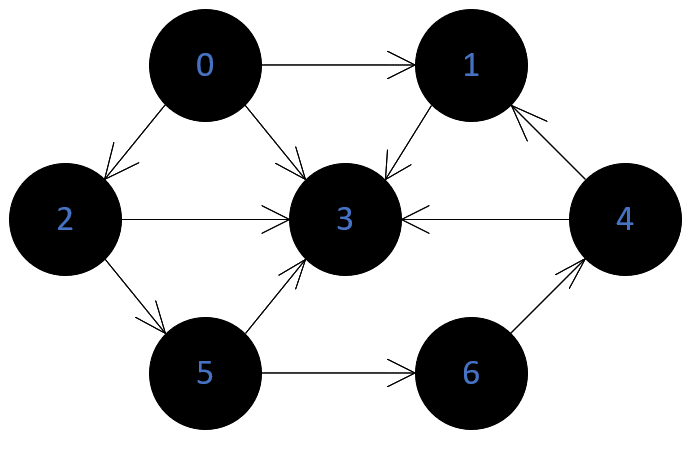
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 6 | 3 | 9 | 7 | 8 |

P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 1 | 6 | 2 | 5 |

F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| I | 5 | 13 | 4 | 10 | 12 | 11 |



t=14

C

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| B | B | B | B | B | B | B |

D

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 6 | 3 | 9 | 7 | 8 |

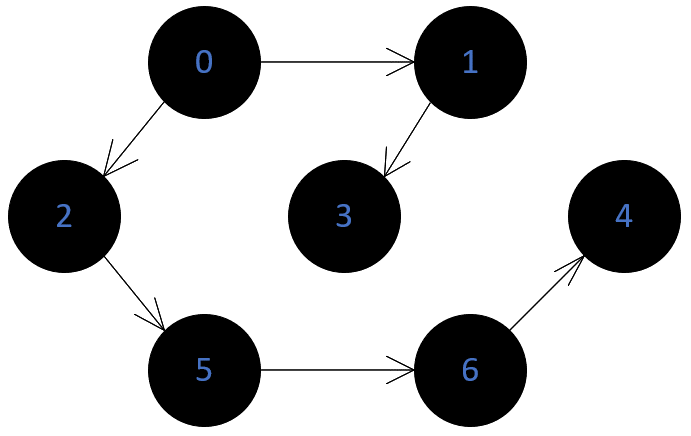
P

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| N | 0 | 0 | 1 | 6 | 2 | 5 |

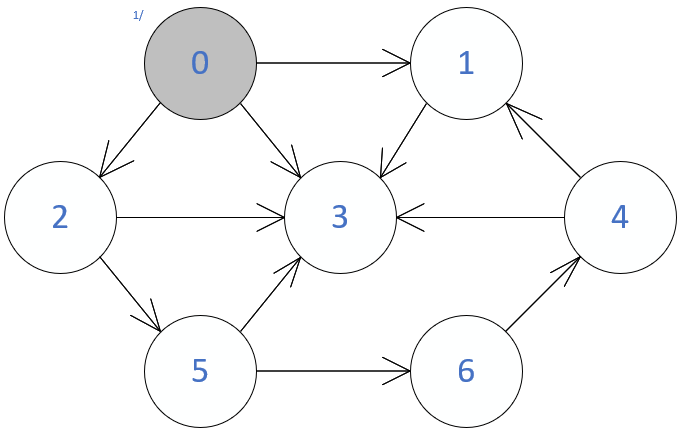
F

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 14 | 5 | 13 | 4 | 10 | 12 | 11 |

**DFS-дерево**



**Топологическая сортировка**

****

**Изображение выглядит как текст, часы

Автоматически созданное описание**

**Изображение выглядит как текст, часы

Автоматически созданное описание**

**Изображение выглядит как текст, часы

Автоматически созданное описание**

|  |
| --- |
| **3** |

**Изображение выглядит как текст, небо

Автоматически созданное описание**

|  |  |
| --- | --- |
| 1 | 3 |

Изображение выглядит как текст, небо

Автоматически созданное описание

|  |  |  |
| --- | --- | --- |
| 0 | 1 | 3 |

Изображение выглядит как текст, часы

Автоматически созданное описание

Изображение выглядит как текст, часы

Автоматически созданное описание

Изображение выглядит как текст, часы

Автоматически созданное описание

Изображение выглядит как текст, часы

Автоматически созданное описание

Изображение выглядит как текст, часы

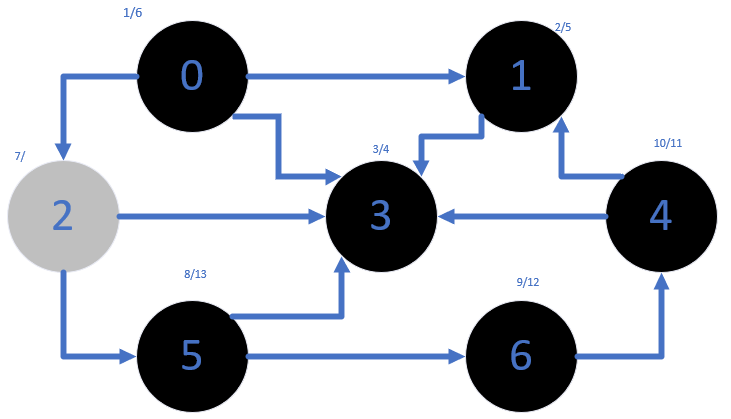
Автоматически созданное описание

|  |  |  |
| --- | --- | --- |
| 4 | 1 | 3 |

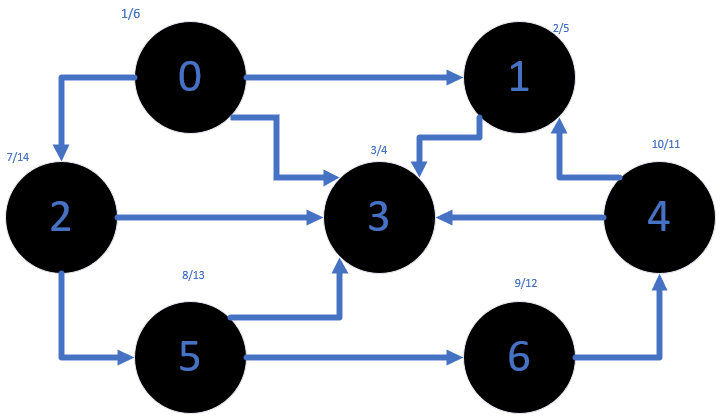
Изображение выглядит как текст, часы

Автоматически созданное описание

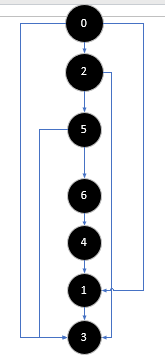
|  |  |  |  |
| --- | --- | --- | --- |
| 6 | 4 | 1 | 3 |



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 5 | 6 | 4 | 1 | 3 |



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 2 | 5 | 6 | 4 | 1 | 3 |



**Задание 2.** Осуществить программную реализацию алгоритмов на C++. Разработать структуры **AMatrix** и **АList**  для представления ориентированного графа матричным и списковым способом. Разработать функции преобразования из одного способа представления в другой. Разработать функцию **BFS** обхода вершин графа, используя метод поиска в ширину. Продемонстрировать работу функции. Копии экрана вставить в отчет.

**Задание 3.**  Разработать функцию **DFS**  обхода вершин графа, используя метод поиска глубину. Продемонстрировать работу функции. Копии экрана вставить в отчет.

**Задание 4.**  Доработайте функцию **DFS**,для выполнения топологической сортировки графа. Продемонстрировать работу функции. Копии экрана вставить в отчет

Изображение выглядит как текст

Автоматически созданное описание

Вывод: Я освоила сущность и программную реализацию способов представления графов; алгоритмов поиска в ширину и глубину; алгоритма топологической сортировки графов.