**Problem 6.1** Scheduling CS Classes as a CSP

**Answer:**

According to the problem description,

Variables ⟹ One variable per class

Domain ⟹ Professors available for that class

Constraints ⟹ In this binary CSP problem, two classes which has time clash could not have same professor

1. **Formulating the problem as a Binary CSP problem:**

*Set of Variables & Domain* are as follows,

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Class Name** | **Class** | **Class Time** | **Variables** | **Domains** |
| Intro to Artificial Intelligence | Class 1 | 08:30 – 09:30 am |  |  |
| Intro to Programming | Class 2 | 08:00 – 09:00 am |  |  |
| Natural Language Processing | Class 3 | 09:00 – 10:00 am |  |  |
| Machine Learning | Class 4 | 09:30 – 10:30 am |  |  |
| Computer Vision | Class 5 | 09:00 – 10:00 am |  |  |

Possible combination of binary constraints , and their suitability according to the class time are as follows,

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  | - | |
|  |  |  |  | - | | - | |
|  |  | - | | - | | - | |

Therefore, *Constraints:*

1. **Constraint Graph:**

Diagram

Description automatically generated

1. **A Total Inconsistent Assignment:**

**A Solution:**

**Problem 6.2** Scheduling CS Classes with Constraint Propagation

**Answer:**

Considering previous binary CSP constraint graph with variables and their respective domain, it looks like,

Diagram

Description automatically generated

1. If we choose most constrained variable, in this case , then assign and run arc-consistency for updating domains,

Diagram

Description automatically generated

Similarly choose and check further,

Diagram

Description automatically generated

Then finally, choose and check further,

Diagram

Description automatically generated

Therefore, running arc-consistency, the binary CSP can discard unnecessary values of all domains or update domains such a way that it can obtain to its solution, which is as follows,

1. Considering above binary CSP constraint graph, all optimal cutsets for the CSP will be,

By discarding ,

Diagram

Description automatically generated

By discarding ,

Diagram

Description automatically generated

**Problem 6.3** CSP Formalization

**Answer:**

According to the problem description the constraint graph will be as follows,

Diagram

Description automatically generated

1. Pairs of variables such that is arc-consistent relative to ,

|  |  |  |  |
| --- | --- | --- | --- |
| Pair | Domain | Constraint | Arc-consistent |
|  |  |  | Yes |
|  |  |  | Yes |
|  |  |  | Yes |
|  |  |  | Yes |
|  |  |  | Yes |
|  |  |  | Yes |

Therefore, of variables such that is arc-consistent relative to :

1. Assignment Table:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  | Partial or Total | Consistent or Inconsistent | Solution |
| \*\*\* | | | | | | P | C | No |
| 0 | 2 | 1 | T | T | T | T | C | Yes |
| \*\*\* | | | | | | T | IC | No |
| 1 | 2 | 0 | T | T | T | T | C | Yes |
| \*\*\* | | | | | | T | IC | No |
| 2 | 1 | 0 | T | T | T | T | C | Yes |
| \*\*\* | | | | | | T | IC | No |

Therefore, all solutions are:

1. After assigning , if we apply forward checking, updated domain will be as follows,