DST-ASSIGNMENT

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All what you want deployed on Github : https://github.com/AbdoAhmedAbdelmonem/Data-Science-tools---NetworkX

Course Scheduling Analysis using Graph Coloring

This notebook analyzes `course scheduling` conflicts by modeling `courses as nodes` and `student enrollments as edges` in a graph. We then use graph coloring algorithms `to find the minimum number of time periods needed to schedule courses without conflicts.`

In [10]:
```
import pandas as pd
import networkx as nx
from itertools import combinations
import matplotlib.pyplot as plt
```

---

1. Data Loading and Preparation

`> Load all sheets from the Excel file`

In [11]:
```
all_sheets = pd.read_excel("studentcoursesedit.xlsx", sheet_name=None)

df = pd.concat(all_sheets.values(), ignore_index=True)

# Rename columns to English for easier handling
```

```
df = df.rename(columns={
    "رقم الطالب": "Student ID",
    "اسم الطالب": "Student Name",
    "التخصص": "Specialization",
    "رقم المقرر": "Course Code",
    "اسم المقرر": "Course Name",
    "رمز المقرر": "Course Symbol",
    "رقم الشعبة": "Branch Number"
})

# Drop unnecessary column
df = df.drop(["م"], axis=1)
print(f"Number of unique courses: {len(df['Course Name'].drop_duplicates())}")

df
```

```
Number of unique courses: 461
```

Out[11]:

	Student ID	Student Name	Specialization	Course Code	Course Name	Course Symbol	Branch Number
0	1105312002	عبدالمجيد علي عبدالرحمن الشاوي	السجلات الطبية-2	110501	المهارات اللغوية	ARAB 101	211637
1	1105311013	سالم سليمان دهش الشمري	السجلات الطبية-2	110501	المهارات اللغوية	ARAB 101	211637
2	1105312004	احمد عبدالله صالح الحربي	السجلات الطبية-2	110511	التحرير العربي	ARAB 102	111647
3	1105321021	يوسف عبدالله سليمان المهوس	السجلات الطبية-2	110511	التحرير العربي	ARAB 102	211647
4	1105312011	سطام بندر جايز المطيري	السجلات الطبية-2	110511	التحرير العربي	ARAB 102	211647
...	...	...	...	...	...	...	...
11098	1501311010	أحمد عبدالعزيز محمد العبيدان	هندسة الحاسب	150147	هندسة البرمجيات	342عال	215153
11099	1401321075	صالح محمد صالح الرميح	علوم الحاسب	150147	هندسة البرمجيات	342عال	115152
11100	1502301005	يزيد محمد صالح الهجرس	علوم حاسب-1	150147	هندسة البرمجيات	342عال	115155
11101	1502312010	محمد عبدالله حميمد العريني	علوم الحاسب	150147	هندسة البرمجيات	342عال	115152
11102	1502312003	صالح أحمد صالح المعتاز	علوم الحاسب	150147	هندسة البرمجيات	342عال	115152

11103 rows × 7 columns

---

2. Data Processing

In [12]:
```
df_unique = df[["Course Symbol", "Course Name"]].drop_duplicates()
df_unique = df_unique.set_index("Course Symbol")

# Count students per course
df_grouped_by_Symbol = df[["Student Name", "Course Symbol"]].set_index("Course Symb
df_grouped_by_Symbol = df_grouped_by_Symbol.groupby("Course Symbol").count()
```

```
df_joint = df_unique.join(df_grouped_by_Symbol, on="Course Symbol")

# Rename columns for clarity
df_part1 = df_joint.rename(columns={"Student Name": "Number of Students"})
df_part1
```

Out[12]:

	Course Name	**Number of Students**
Course Symbol		
ARAB 101	المهارات اللغوية	6
ARAB 102	التحرير العربي	4
BIOL 101	Biology	1
ISLM 103	النظام الإقتصادي في الإسلام	1
ENGL 102	English Language 2	3
...	...	...
عال493	مواضيع مختارة في علوم الحاسب	1
عال 339	نظرية الحوسبة	2
عال227	نظم التشغيل	7
عال381	نظم إدارة قواعد البيانات	1
عال342	هندسة البرمجيات	23

486 rows × 2 columns

---

3. Graph Construction

In [13]:

```
student_course_pairs = [(row['Student Name'], row['Course Symbol']) for index, row

# Create dictionary of students and their courses
final_dict = {}
for student, course in student_course_pairs:
    if student not in final_dict:
        final_dict[student] = []
    final_dict[student].append(course)

# Build the graph
Graph = nx.Graph()

# Generate all possible course pairs that share students
generated_pairs = []
for courses in final_dict.values():
    generated_pairs.extend(combinations(courses, 2))

# Add edges to the graph
```

```
Graph.add_edges_from(generated_pairs)

# Print graph statistics
print("Number of Edges:", Graph.number_of_edges())
print("Number of Nodes:", Graph.number_of_nodes())
```

```
Number of Edges: 5311
Number of Nodes: 479
```

---

4. Graph Coloring Analysis

> Graph Coloring Comparison...

In [14]:
```
def analyze_coloring(strategy_name, coloring_func):
    """Helper function to analyze each coloring strategy"""
    coloring = coloring_func(Graph)
    df = pd.DataFrame(list(coloring.items()), columns=["Course Symbol", "Period"])
    df = df.astype({"Course Symbol": str, "Period": int})

    max_period = df["Period"].max()
    max_courses = df[df["Period"] == max_period]

    print(f"\n{strategy_name} Results:")
    print(f"Number of periods needed: {max_period + 1}")
    print(f"Courses in final period ({max_period}):")
    print(max_courses.to_string(index=False))

    return df
```

Analyze all three strategies

In [15]:
```
strategies = [
    ("Connected Sequential BFS", lambda G: nx.coloring.greedy_color(G, strategy="co
    ("Largest First", lambda G: nx.coloring.greedy_color(G, strategy="largest_first
    ("Connected Sequential DFS", lambda G: nx.coloring.greedy_color(G, strategy="co
]

results = {}
for name, func in strategies:
    results[name] = analyze_coloring(name, func)

comparison = pd.DataFrame({
    'Strategy': [name for name, _ in strategies],
    'Periods Needed': [results[name]['Period'].max() + 1 for name in results],
    'Courses in Final Period': [len(results[name][results[name]['Period'] == result
                                for name in results]
})
```

```
Connected Sequential BFS Results:
Number of periods needed: 22
Courses in final period (21):
Course Symbol  Period
      224 21      دوي

Largest First Results:
Number of periods needed: 21
Courses in final period (20):
Course Symbol  Period
      420 20      صكل

Connected Sequential DFS Results:
Number of periods needed: 22
Courses in final period (21):
Course Symbol  Period
      418 21      دوي
```

---

5. Final Output Preparation

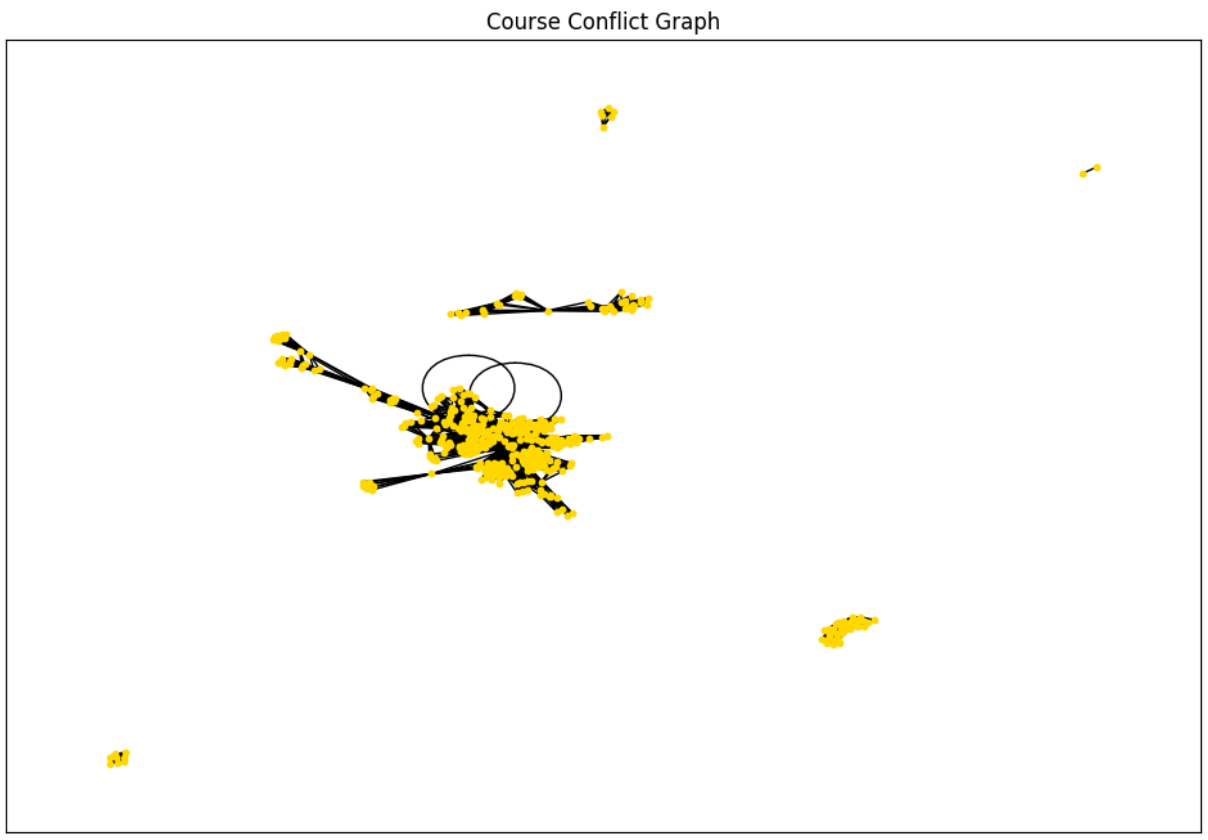
In [16]:
```python
df_unique = df[["Course Symbol", "Course Name"]].drop_duplicates().set_index("Cours
df_student_count = df[["Student Name", "Course Symbol"]].groupby("Course Symbol").c
    columns={"Student Name": "Number of Students"})

final_output = results["Largest First"].set_index("Course Symbol")
final_output = final_output.join(df_unique).join(df_student_count).sort_values("Per
final_output.to_excel("combined_course_scheduling.xlsx")

print("\nFinal schedule saved to 'combined_course_scheduling.xlsx'")
```

```
Final schedule saved to 'combined_course_scheduling.xlsx'
```

---

6. Visualization

In [17]:
```python
pos = nx.spring_layout(Graph)
plt.figure(figsize=(12, 8))
nx.draw_networkx(Graph, pos, with_labels=False, node_color="gold", node_size=10)
plt.title("Course Conflict Graph")
plt.show()
```



`Abdelrahman Ahmed Abdelmonem`

`23011311`
