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DAA LAB-6

Aim:

1. To find longest common subsequence of sequence of grades received by 20 students

2. To find fastest way to multiply matrices of meteorological data using matrix chain multiplication algorithm

3. To understand and implement SOLID principles of software development

Experiment task 1:

Input:

Positive test cases

	A	B	C	D	E	F
1	Student ID	Grades				
2	S1	DDBCBCBCDDFFAABCDDCCABCCAACDFFBCDDDDFFFF				
3	S2	DDFFCCCCAACDDDFFABCDBBBBBCCCAABBBBBBCCBC				
4	S3	BCFFAACDCCBBDDCCCCABDDDDCCDDCCBCBCBCABBC				
5	S4	BBBCCCDDABBCBBCDCCBBBBBBBBCCBCCCBCCDABFF				
6	S5	ABCCABBBDDDDCCABBCABFFFFBCCDFFCDCCBCFFFF				
7	S6	CDAACDBCCCBBCCBBAADDAAAABBAAABCCBBABAACC				
8	S7	BCCDABDDCCAACCAABBBBAACCAAAAAACCDDBBAADD				
9	S8	DDCDDDBCFFBBCCAABCBBABAAFFBBAAAADDBBBBDD				
10	S9	CCBBBCFFBCDDDDCCBBCDCCBCCCBCAADDAACDABAB				
11	S10	AACCDDAAAADDAABBCCDDFFBBBCDDCDBCCDFFAAAB				
12	S11	ABABBBCCCDDDDDDDCDBBCCCDFFFFAACCABABABCD				
13	S12	DDBBAAFFBCAADDAAABCCFFABAABBFFAACDCDAACC				
14	S13	CDDDCCCCDDFFBCDDBBBBCCBBABBCBBABAAFFBBBC				
15	S14	ABDDFFBBBCFFCDCCFFFFCDDDCCBCABCDABBCBCFF				
16	S15	CCCCCCFFAACCAACCBBDDCDABBCBCCCDDCDBCAAFF				
17	S16	DDCDCDDDFFAADDAADDCDBBABBBFFBBCDDDDDCCFF				
18	S17	CCAACCDDABCDABAABBCCBBDDAACCAAABBBDDDDBB				
19	S18	BBBCBBBCCCCCABFFCDAADDBBBBBCAACCCCBCBCFF				
20	S19	AADDCDCDCDBBBCBBDDFFCDABBCCCBBFFCDABCDFF				
21	S20	BCABDDABAAAABCCCCDBCCCFFABCDABCDDDAAAACC				

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	A	B	C	D	E	F	G
1	Student ID	Grades					
2	S1	BCFFBBDDABBCDDFFABCCCDDDFFBCBBAAAADDBCBC					
3	S2	DDDDCDFFFFBBCDABAAAAAABDDAAAABBCCAAAABBFF					
4	S3	CDAAAABCCCCDFFAADDAAABDDDDBBFFCCCDCCFFBB					
5	S4	ABCCAABCFFCCAAABCCBBABCDCCBCFFABCCFFAACD					
6	S5	AADDBBCDBBBBAAFFABBBDDBCAABBCDFFCDDDBBAB					
7	S6	DDBBFFABFFAABCDDABFFABFFFFCDCDBBCDABDDFF					
8	S7	BCCCAACCAABBDDBBCCBCFFCCBCFFCCAAAABBCCBB					
9	S8	FFABABAABCFFBBCDBBABAABCBCFFDDAACCAACDBC					
10	S9	ABBBAABBFFCCCDFFCDAACDAABBFFDDABAABCBBCD					
11	S10	DDDDCCFFFFFFCDABAACDAABCFFCDBBDDABDDAACC					
12	S11	ABABAABCCDBBDDABABFFCDFFCDCDCDABABCDBBFF					
13	S12	CCCCBCFFDDCDBBAACDDDAABBCDCCCCCCAADDBCAA					
14	S13	CDBBBCFFFFAADDBCABBBABFFAABCBBBCFFCDCDCD					
15	S14	BBABCDAABBDDBBAABCBBBCAACDAABCBBCDCCABCD					
16	S15	AABBDDAACDAACDCDCDAAAABCFFBCFFABCCAABBDD					
17	S16	FFBBDDABFFBBCDBCABFFAACDBBABCCDDDDAABBBC					
18	S17	BBDDCCCCBBBCBBAADDDDBBCDAABCCDAACDFFDDCC					
19	S18	AAAABBCDDDBBABDDBCCCCCBCBBBCAABCBBDDABCD					
20	S19	CDABBCDDDDABBBAAABBBCDFFCCBCAAFFAAABCDFF					
21	S20	CDBCABABABCDFFAABBFFBBBCBBAADDBCBBBBCCCC					

	A	B	C	D	E	F
1	Student ID	Grades				
2	S1	CDBCCCDDCDBCDDAACCBBDDBCBBDDBCABBBAAAADD				
3	S2	FFDDABFFBCBCAAAACDBCBBABBCABFFCCAAAABBBC				
4	S3	AABCCDFFAAABBCBCCCCCFFCCCDDDCCAADDBCFFBC				
5	S4	CCBCAAFFCCCDBCBCCDBCDDFFAACCAACCAADDABFF				
6	S5	BCCCCCBCCDCDAACDFFAADDFFBBDDDDBBCDCCFFAA				
7	S6	BBBBDDCCDDCDABBCCDAAABBCBCBCBBCDDDDDCCBC				
8	S7	BBFFBCBCABCCABCDFFCDCDFFAACCFFFFFFCCCCCC				
9	S8	BBCCBCFFAAFFAABCCDFFCCABFFABFFFFCDABFFBC				
10	S9	CCDDAAFFBBBCAAABCDBCDDFFFFCCCDABABBBCCAA				
11	S10	ABBBABAACCAABBABCCBCCCAABBABCDDDBBAAFFAB				
12	S11	BCCDCCCDDDCDFFCCAACDABCDDDAACDDDABBCAAAB				
13	S12	FFABBBFFCDDDDDCDBBFFFFCDBCCDBBDDFFAABBAB				
14	S13	AAAACDFFDDCDCDABBCBCBBCDBBBBBCDDBBDDAABB				
15	S14	DDCDABDDBCAADDFFCDCDDDCCABFFCDABDDABCCFF				
16	S15	CDBCBCABCDCDBCCDCCABFFCDAAFFABABBBCCCCDD				
17	S16	BBABBBAACCCCCCFFBBFFFFDDBCBCFFAAFFBBCDBC				
18	S17	BCBCBCDDFFDDCCFFABBCCCBCAACDCDBCCDABABDD				
19	S18	ABAADDAABBCCAABBABDDBCCCDDCDCCFFFFABAACD				
20	S19	BBDDBCBBBBBCCDABFFCCABAACCCCDDFFDDCDDDAA				
21	S20	BCBCDDCDBBAACDBCFFDDAACCBBABCCDDAACDCDAA				

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	A	B	C	D	E	F
1	Student ID	Grades				
2	S1	AAFFCDABDDCCAACCBBBBBBCCCCCDBCBBDDABCDBC				
3	S2	BBCCCDDDDDCCBBBCAAFFCDBCAAABBBCDABFFFFAA				
4	S3	AACCBBDDABDDBCDDCCBCBBFFCDAACDAABBAABCBC				
5	S4	CCFFCDABFFCCCDDDAACCABCCDDDDAAABFFDDBCFF				
6	S5	BBCCDDCDABBBCCCDABAADDFFBBDDCCAAABAADDBC				
7	S6	AACCCCBBCDCDCCABAADDFFFFAAAAABCDAAFFBBDD				
8	S7	AACDBBCDBCFFAAFFCDABAAAACCCDBCFFCCABAABC				
9	S8	DDABFFBBBCABCCCDBBFFAADDFFCDAABCBBDDBBCC				
10	S9	CCFFCCBBAACDCDAABBAABBAABBCCDDCCBBFFBBCD				
11	S10	ABCCAACCABFFDDAADDDDCCFFBCDDFFBCAABBBCBC				
12	S11	BCFFABBCFFFFAACDFFCDFFABCCBCFFDDAABBCCAB				
13	S12	DDBBAAABBBBBCDDDCDABFFCCFFABCDFFAAABCCBB				
14	S13	CCBBABFFDDBBCCCDBBFFAACCCCBBFFCCDDABBCCD				
15	S14	BCCDFFABDDABDDBCAACCBBCCBBCDABBBABBCFFDD				
16	S15	CCAAABBCBBCDBCDDBCBCFFABCDABABAACCABCDDD				
17	S16	DDAACCABAAAAAAABBCCDAABBFFFFCCFFCCBBCDBC				
18	S17	BBCDCCAACDFFBBABCDCDBCAAABFFAACCCCCDDDCC				
19	S18	AAFFAAABBBDDDDFFCCABCCBCAABCCCABAACDCCDD				
20	S19	BBFFBCDDCCABABCDFFCCAACCBBBCAABCCCBCDDFF				
21	S20	BBAACCDDAAAAAABCBBFFDDBBAADDCDABBCBCCCCC				

	A	B	C	D	E	F
1	Student ID	Grades				
2	S1	FFBBAABBCCABBBBBCCAADDCDCDABABBBFFBCBCAA				
3	S2	CCFFBBBBDDBCABABBBFFABCCFFCDABAAAAAABCCD				
4	S3	DDCCBCBCFFABBBDDDDAABCAACDABAAABCCCDCCBC				
5	S4	BBABABAABCDDCDDDBBAAABAAABCCFFDDCDCCDDAA				
6	S5	AAABDDCCAABCAABBDDDDDDBCCDBBCDCDABBCABAA				
7	S6	CCCCAABCBBFFBBCDBBBCABBBAADDDDFFBBBBABAA				
8	S7	ABBBABDDCCAACDBBDDCDCDBBCCAADDBCCDBCABCC				
9	S8	ABDDBCCDFFDDAABBFFBBAAABBBAAFFCCBBABDDFF				
10	S9	DDABCCBCFFCDCCBBCCBBBCAACCDDDDAABBBBFFCC				
11	S10	CDABDDBBCDCDBBCCCCBBCCAABCCCBCBBBCABABFF				
12	S11	ABCCDDABBCABCDCCCDCCFFFFABAAABDDABBCCCFF				
13	S12	BBDDFFABCCDDCCAAABAACCAAAAAAAABABCCBBFFFF				
14	S13	BBBCBCBBABCCBBBBAACCBBAABCCCCCBBCDDDBCCC				
15	S14	BCCDCDFFDDABBCFFCDCDBCBBBCCCBCBBCDBBCCBC				
16	S15	FFDDBBABCCCDABFFAABBAAABCCCDCCBCBCCDCCDD				
17	S16	BBFFBCBCAACDCDBCAABBDDCDCDABDDBBABBBCCAA				
18	S17	ABCDBBCDAAFFBCDDABABCCAAABFFBBAADDCCBBAB				
19	S18	ABCDBBAABCCDCDBCBBABFFABCCCDCCABBBCCABDD				
20	S19	FFBCCCDDAAABAADDDDBBFFBCCCDDBBFFCDDDCDDD				
21	S20	FFBBAAFFBBABFFBCABBBCDCDAAAABBCCBBCDABCD				

Negative test cases

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	A	B	C	D	E	F	G
1	Student ID	Grades					
2	S1	CDBCFFBBAACCDDDDCCBB					
3	S2	BCCDDDCDBBCCCDAAABBBFFCDBCCCDDBCAACCCD$@					
4	S3	FFFFBBAAAABCBBCDCDABBCFFFFBCFFCCABFFAA$@					
5	S4	CDAAAAFFDDCCAAFFABABCCAACCBCFFAACDFFAB1A					
6	S5	FFCCBCCDDDCCFFBBAADDCDBBBBAAAACDFFAABB1A					
7	S6	DDBBFFAACCCCFFCDCCAB					
8	S7	AAAABBFFCCCCBBBCCDABAABCAABBAABBABCCBB$@					
9	S8	BCCCBBABBBDDDDAABBBB					
10	S9	AAABABABDDABCCABCDCD					
11	S10	CDCDAACCABAAAAFFFFBB					
12	S11	CDBCCDAAAAABABCCDDCD					
13	S12	ABCCCCFFCCCCCCDDAADDDDCCAABBAABCBCBCCD$@					
14	S13	BCFFCDAAAADDAADDFFBBAADDCCCCBCDDABAAAB1A					
15	S14	BBAAFFAACDFFBCAAFFFF					
16	S15	ABDDBCCDFFBBBCCCCCCD					
17	S16	CDBCBCCCCDBBCCDDAACDCCCDBBDDABBBAABCBC1A					
18	S17	ABDDCDCCCDBCFFBBCCCC					
19	S18	CCBBCDFFBCFFCDAABCCCCDAACDAABBAAABAACC$@					
20	S19	BBCCDDFFAAAAFFAABBAB					
21	S20	CCDDDDDDDDBCAABCDDDDAAABCDBCABAAABBCAB1A					

	A	B	C	D	E	F
1	Student ID	Grades				
2	S1	AABCAACDABBCBCDDDDABAAABCDFFABCDDDDDFF$@				
3	S2	DDBBDDCDAAABAACCABDDDDFFFFBCDDCCCCABDD$@				
4	S3	ABBBBBBCBCCDFFFFCDCCBCBBBBBCCCFFCDCCFF$@				
5	S4	AACDCDABCDBCFFDDCDCD				
6	S5	DDCCAACDCDBBAAFFDDDD				
7	S6	ABCDDDDDCDBBAABCDDBC				
8	S7	AACCDDDDDDABCDBBABCCFFABFFABBBFFFFBCBB1A				
9	S8	CCFFCCBBBCFFDDDDBCAABCFFABCDBBAACDDDAA1A				
10	S9	AAFFBBDDDDCDBCDDCDDD				
11	S10	BCABAADDCDCCAACDCCCDCCCDCCDDCDFFAABBAB$@				
12	S11	CCABDDBCAABBBCFFCCFF				
13	S12	BCBBCCCDCCABBCBCDDCDCDBCDDAACDABCDBBCD$@				
14	S13	FFAAABCDFFABFFFFCCAB				
15	S14	AABCAAABDDCDABDDFFBC				
16	S15	AAAABCDDBBDDBBAAABCDAACCDDDDBBCDAACCFF$@				
17	S16	CCABDDCCABCCBCCCCDFF				
18	S17	BBBBFFCCBCCCABCCAABCBCFFBBFFCDCCBCAABC$@				
19	S18	DDDDDDCCABCCAAABAACCCDCDBBCCABABABCCBB$@				
20	S19	FFCCFFFFBBCCABCDCCDDCDABCCABCCBCDDDDBC$@				
21	S20	DDFFABBCBBCCCDFFCDFFDDABBCDDFFFFBCCCBC$@				

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	A	B	C	D	E	F	G
1	Student ID	Grades					
2	S1	CCFFCDDDCCCDCDCDABDDDDBBCDCCDDABCCBBDD$@					
3	S2	ABFFBCABBCAACDBBFFCDBBDDCCDDFFBBCCCDBC$@					
4	S3	CCBBAADDAACCBBBBCCFFABCCBBDDBBBCDDCDDD1A					
5	S4	AAAADDFFBCDDCDBBFFDD					
6	S5	BBDDCDCCBCDDBBABDDBB					
7	S6	CCCCDDFFFFBCCDCCDDAA					
8	S7	BCBBBBCCCCCDBBCCCDCDCDDDBCBBBCAAFFAAFF1A					
9	S8	CDFFDDABFFCCCDBCCDBBCDFFCCFFABCDAABCFF1A					
10	S9	CCDDABCDBBAAFFCCBCAACDDDFFDDCCABCDAAAB$@					
11	S10	AABCFFAACCBBDDABDDDDAAFFCCBCCCAACCDDFF1A					
12	S11	BBABFFCDFFDDBCFFAADD					
13	S12	CDBCBBCCABBBFFDDAACCBCFFBCCDCCDDCDBBAA1A					
14	S13	CCFFAABCFFCDBBDDFFCDABABBCBBABABAAAACD$@					
15	S14	ABCDCDCCAAABAABBAAAA					
16	S15	BBBCCDBBCCCDBBBCCDFFCDABABFFBBDDFFAAFF$@					
17	S16	ABCDABCCDDAACCFFFFCDFFBBBCFFAACDFFBBCD$@					
18	S17	CCDDFFDDDDBCFFBBFFBB					
19	S18	CCCCAACCCCCCBCBBBBBC					
20	S19	DDAACCABCCCDDDABCCCDDDABCDDDCCCDCDBBBC$@					
21	S20	AAAABBCCBCAAAADDFFCCDDAAABDDCCCCBCCDBB$@					
22							

	A	B	C	D	E	F
1	Student ID	Grades				
2	S1	BBAAFFCCDDAABCCDBBCDFFAABCAABBAADDFFBB1A				
3	S2	ABBCFFABBBCCCDBCDDABBBDDBBCCABFFBBABCC$@				
4	S3	BCCDCDAACCAAAADDABCD				
5	S4	BBABCCFFABAACDABBCAAFFABDDFFABCDFFBCCD1A				
6	S5	FFFFAABCCCDDFFFFCCBBFFCCCCFFCDBBFFABBC1A				
7	S6	ABBCCDDDFFCCAABBAACD				
8	S7	FFCDBCBCABCDDDCCFFAABCAABCCCCDBCFFDDAA$@				
9	S8	ABAAAABCAABBABDDAABCDDBCDDBBCDAAFFCDAA1A				
10	S9	CCDDAAAAFFABFFDDBBFF				
11	S10	BCCDAACCBBFFFFBCCCCDFFBBBBCCBBCDFFFFDD$@				
12	S11	CDDDAAAAFFBCBCAAAACCCCCDBCBCABCCAABBCD$@				
13	S12	BBFFBCFFFFDDDDFFCCABFFCCCDCDCDBCFFFFFF1A				
14	S13	AAFFABFFBCAADDFFFFCDBCCDABBCBBFFCCBCAB$@				
15	S14	ABBBAAFFBBAAFFBBCCAA				
16	S15	DDFFBBCCBCBBBBDDCDCCBCCCAACCAAFFBCBBDD$@				
17	S16	CDABCCABBBCDFFAABBBB				
18	S17	CCAACDBBFFABBBBBCDABBBDDCCBCFFBCFFABBB$@				
19	S18	FFFFFFCCBCBBABAAABCDFFDDCCABBCABCDAADD$@				
20	S19	FFABCCABBBABFFCDFFBCFFCCFFFFCDBCDDDDDD1A				
21	S20	BBBCCCABABABFFFFAABBCDCCFFBBAACCFFDDBB1A				

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	A	B	C	D	E	F	G
1	Student ID	Grades					
2	S1	CDCDFFABBBAACCCCCCABCCCCCCCCDDCDCCCCFF$@					
3	S2	DDBBDDAADDCCABABCCFFABDDCDBCFFDDBCABBC1A					
4	S3	CCDDCCBBFFDDCDBBABABCDAABCFFABBBDDCDFF1A					
5	S4	ABABDDAADDABBBDDCDCDFFFFBCBBDDFFCCAAAB1A					
6	S5	CCFFAACDBCCDCCABDDAABBCCCDCDABFFCCCCFF1A					
7	S6	BCCCCCCCDDDDBCCCBCAB					
8	S7	CCCDABABBBBCCDCDFFCDABCCABBCDDCCAACCCD1A					
9	S8	CCDDABCCFFCCDDABAABCCDFFCCCDDDDDCCCDAB$@					
10	S9	ABCDCDABBCCDFFAABBFF					
11	S10	BCBCAABCDDFFBBCDABAADDFFCCBCCDABCDCCBB$@					
12	S11	BBFFBCBCCCBCCCBCABCD					
13	S12	BCABCCBCAAAACDCCAAFFFFABAADDAAFFCDFFAA1A					
14	S13	DDDDAADDFFABFFAAABABABFFFFCCCCBCBBCCAB1A					
15	S14	FFFFBCCCBCBBBCBBFFABCDAADDCDFFCDCCCDBC1A					
16	S15	DDAABBBCAABCABCDAABBAACDBCABBBBCBBAAAB$@					
17	S16	CCABABCDDDAACDDDCCAABBDDDDBCABBCFFAAAA1A					
18	S17	FFFFBCDDFFDDDDABFFBCCDABBCDDCCBCCDCDDD$@					
19	S18	CDAABCAABBABBCFFDDBB					
20	S19	DDBBBBAABCCCAACCABCDBBCDAABBFFBBBBBCDD1A					
21	S20	CDAABBCCCDCCCCDDAABBDDCCCDBBBCFFDDCDBC1A					

Output:

```
Positive Test Cases:
Longest Common Subsequence for Positive Test Case 1: DCCCBC
Longest Common Subsequence for Positive Test Case 2: BBCBB
Longest Common Subsequence for Positive Test Case 3: CBBAA
Longest Common Subsequence for Positive Test Case 4: CCBCCBBC
Longest Common Subsequence for Positive Test Case 5: BBBBBBC

Negative Test Cases:
Error for student S2: Invalid grade sequence: BCCDDDCDBBCCCDAAABBBFFCDBCCCDDBCAACCCD$@. Special characters or invalid grade format de
tected.
Error detected in Negative Test Case 1. Skipping LCS calculation.
Error for student S2: Invalid grade sequence: DDBBDDCDAAABAACCABDDDDFFFFBCDDCCCCABDD$@. Special characters or invalid grade format de
tected.
Error detected in Negative Test Case 2. Skipping LCS calculation.
Error for student S2: Invalid grade sequence: ABFFBCABBCAACDBBFFCDBBDDCCDDFFBBCCCDBC$@. Special characters or invalid grade format de
tected.
Error detected in Negative Test Case 3. Skipping LCS calculation.
Error for student S2: Invalid grade sequence: ABBCFFABBBCCCDBCDDABBBDDBBCCABFFBBABCC$@. Special characters or invalid grade format de
tected.
Error detected in Negative Test Case 4. Skipping LCS calculation.
Error for student S2: Invalid grade sequence: DDBBDDAADDCCABABCCFFABDDCDBCFFDDBCABBC1A. Numbers found in the sequence.
Error detected in Negative Test Case 5. Skipping LCS calculation.
PS C:\Users\Kevin Shah\OneDrive\Desktop\SY\DAA\Assgn 6\task1>
```

Experiment task 2:

Input:

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```
test_cases = [
    # Valid test cases (positive test cases) for meteorological data (assuming 5 cities)
    ([7, 5, 4, 6, 7, 8], 5),  # Example with matrix dimensions: 7x5, 5x4, 4x6, 6x7, 7x8
    ([3, 7, 5, 10, 15], 4),  # Example with matrix dimensions: 3x7, 7x5, 5x10, 10x15
    ([2, 4, 5, 6, 8], 4),    # Example with matrix dimensions: 2x4, 4x5, 5x6, 6x8
    ([4, 8, 6, 7, 9], 4),    # Example with matrix dimensions: 4x8, 8x6, 6x7, 7x9
    ([7, 3, 6, 4, 8], 4),    # Example with matrix dimensions: 7x3, 3x6, 6x4, 4x8

    # Invalid test cases (negative test cases)
    ([3, 7, 4, 7, 5], 5),    # Invalid: Missing one dimension for multiplication (4 matrices)
    ([2, 5, 6], 1),          # Invalid: Not enough matrices for multiplication
    ([10, 20, 30], 2),       # Invalid: Matrix dimensions array length doesn't match the number of matrices
    ([10, 20], 1),           # Invalid: One matrix (should have 2 for multiplication)
    ([10, -20, 10], 2),      # Invalid: Negative dimension value
    ([0, 20, 10], 2),        # Invalid: Zero dimension value
]
```

Output:

```
Test case with N=5 and arr=[7, 5, 4, 6, 7, 8]: 504
Test case with N=4 and arr=[3, 7, 5, 10, 15]: 255
Test case with N=4 and arr=[2, 4, 5, 6, 8]: 100
Test case with N=4 and arr=[4, 8, 6, 7, 9]: 360
Test case with N=4 and arr=[7, 3, 6, 4, 8]: 156
Test case with N=5 and arr=[3, 7, 4, 7, 5]: Error: The dimensions array length must be N+1
Test case with N=1 and arr=[2, 5, 6]: Error: There must be at least two matrices for multiplication
Test case with N=2 and arr=[10, 20, 30]: 0
Test case with N=1 and arr=[10, 20]: Error: There must be at least two matrices for multiplication
Test case with N=2 and arr=[10, -20, 10]: Error: Matrix dimensions must be positive values
Test case with N=2 and arr=[0, 20, 10]: Error: Matrix dimensions must be positive values
```

Task 1:

SOLID PRINCIPLES

The **SOLID** principles are a set of design guidelines in object-oriented programming that help create robust, maintainable, and scalable software.

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1) The Single Responsibility Principle (SRP)

A class should have only one reason to change, meaning it should have only one job or responsibility.

Example:

```
class OrderProcessor:
    def process(self, order):
        print("Processing order:", order)

class OrderRepository:
    def save(self, order):
        print("Saving order to database:", order)

# Usage
order = {"id": 1, "items": ["apple", "banana"]}
processor = OrderProcessor()
repository = OrderRepository()
processor.process(order)
repository.save(order)
```

2) Open-Closed Principle (OCP)

A class should be open for extension but closed for modification.
Example:

```
from abc import ABC, abstractmethod

class Notification(ABC):
    @abstractmethod
    def send(self, message):
        pass

class EmailNotification(Notification):
    def send(self, message):
        print("Sending email:", message)
```

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```
class SMSNotification(Notification):
    def send(self, message):
        print("Sending SMS:", message)

# Usage
notifications = [EmailNotification(), SMSNotification()]
for notifier in notifications:
    notifier.send("Hello, World!")
```

3) Liskov Substitution Principle (LSP)

Objects of a superclass should be replaceable with objects of its subclasses without affecting the program's behavior.
Example:

```
from abc import ABC, abstractmethod

class Bird(ABC):
    @abstractmethod
    def fly(self):
        pass

class Sparrow(Bird):
    def fly(self):
        print("Sparrow flying")

class Penguin(Bird):
    def fly(self):
        raise NotImplementedError("Penguins can't fly!")

def make_bird_fly(bird: Bird):
    try:
        bird.fly()
    except NotImplementedError as e:
        print(e)

# Usage
sparrow = Sparrow()
penguin = Penguin()
```

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```
make_bird_fly(sparrow)
make_bird_fly(penguin)
```

4) Interface Segregation Principle (ISP)

A client should not be forced to implement an interface it does not use. Instead, interfaces should be specific to client needs.

```
from abc import ABC, abstractmethod

class Printer(ABC):
    @abstractmethod
    def print_document(self):
        pass

class Scanner(ABC):
    @abstractmethod
    def scan_document(self):
        pass

class AllInOnePrinter(Printer, Scanner):
    def print_document(self):
        print("Printing document")

    def scan_document(self):
        print("Scanning document")

class BasicPrinter(Printer):
    def print_document(self):
        print("Printing document")

# Usage
aio_printer = AllInOnePrinter()
basic_printer = BasicPrinter()
aio_printer.print_document()
aio_printer.scan_document()
basic_printer.print_document()
```

5) Dependency Inversion Principle (DIP)

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High-level modules should not depend on low-level modules. Both should depend on abstractions.

```
from abc import ABC, abstractmethod

class Database(ABC):
    @abstractmethod
    def save(self, data):
        pass

class MySQLDatabase(Database):
    def save(self, data):
        print("Saving data to MySQL:", data)

class MongoDB(Database):
    def save(self, data):
        print("Saving data to MongoDB:", data)

class DataHandler:
    def __init__(self, db: Database):
        self.db = db

    def save_data(self, data):
        self.db.save(data)

# Usage
mysql_db = MySQLDatabase()
mongo_db = MongoDB()
handler = DataHandler(mysql_db)
handler.save_data("Order Data")
handler = DataHandler(mongo_db)
handler.save_data("User Data")
```

Conclusion

1. We have implemented the longest common subsequence algorithm using dynamic programming and found the longest common subsequence for 20 sequences of grades.

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2. We have found the least number of multiplications to multiply meteorological matrix data using dynamic programming.

3. We have studied and implemented the 5 SOLID Principles using sample classes and objects.