

# Software engineering tasks (midterms and exams)

Software engineering

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## 1 Midterm 1

### 1.1 Task 1

If you have already flown a passenger plane, you have already walked through these. Airport check-in and security control present at every airport. The specific functionalities of the system vary from airport to airport, while they are basic functionality common to all airports, namely:

- The system enables the check-in of an individual passenger or the registration of an organized group of passengers with guides registered by the system as individuals.
- In addition to the regular passenger, the system also knows the passenger with special needs and the minor passenger.
- The system also enables the check-in and check-in of luggage upon check-in, with the system distinguishing between passengers traveling with luggage and those without luggage. The system also allows you to check in luggage at the counter to register "counter check-in" or to register at the "kiosk check-in" machine and thus, in both cases, to submit luggage into the baggage management system.
- In addition to the above, the system allows constant control of the movement of the passenger (s) in the area airports.

Based on the required functionalities, **compile the UML of the "Use case diagram"**!

### 1.2 Task 2

Safe home smart home management system in addition to the alarm and video surveillance system, it also has some systems to increase the comfort of residents. One of these solutions is an automatic humidification and dehumidification system that controls the humidification unit in living room, which has the following functionalities:

- The system consists of a 5l tank, a humidifying unit and a dehumidifying unit.
- A water level sensor is installed in the unit tank.
- System based on water level sensor data via automatic tap from the tap mains supply water to the tank if the water level falls below 1 l, and open the water drain valve if the water level rises above 4l.

- The humidifying or dehumidifying unit is switched on based on the humidity sensor settings, which when the unit is switched on constantly measures the humidity in the room.
- The user can set the on / off time on the control panel, turn on / off the device, and set the desired percentage of humidity in the room.

Based on the required functionalities, compile a **UML state machine diagram**!

### 1.3 Task 3

Using the **UML diagram** of the Application Example, describe the operation of the ATM. The ATM provides the user with cash services without visiting the bank counter. The interface thus allows the user to set up a session, part of which is t.i. financial transaction. We consider cash withdrawal, cash deposit, transfer and verification of account balance information as a financial transaction. To use the services of an ATM, the user must first insert a bank card and enter the PIN code after establishing the session. Any transaction performed by an ATM user is performed in connection with a bank account at the Client's Bank. In addition to the aforementioned services, the ATM also provides maintenance, where the maintainer can turn the ATM on or off, and check the operation of the entire system. The verification itself is performed using the services of a normal user, where the maintainer uses a special bank card, which allows you to perform banking transactions on a special bank account without entering a PIN code.

### 1.4 Task 4

Assemble a **sequence UML diagram**, to use an alarm clock that works on as follows: The alarm clock consists of three main units, namely Controller, Timer and Alarm. The user monitors the current time displayed on the alarm screen via the Controller and can at any time via the Controller set, ring time. The alarm clock saves the ringing time setting in t.i. Timer. The moment the user completes the alarm time setting, the Controller flashes the selected alarm time on the display and after 5s it switches to the current time display again. When the alarm time comes, the Timer starts the process in the Controller, which triggers the Alarm. At this point, the alarm starts ringing relentlessly. The user (tired of ringing) triggers the Alarm interruption via the Controller and thus stops the ringing.

### 1.5 Task 5

You recently bought the book "UML 2 For Dummies" in an online bookstore, which you immediately studied as an aspiring young computer engineer. To test your knowledge, you have decided to try to study the structure of the system through which you bought the book. You searched the web for a description of how an online bookstore works and learned that a purchase in an online bookstore happens after the following sequence of events: As an online shopper, you could search the online store for the book you want to buy and then review search results. You were able to view the details for the selected book and then possibly add it to your cart. You have completed your purchase by entering your payment information and delivery address and confirming your order. Three days later, you received the book in the mail at your home address. For the described example, **create a UML sequence diagram**.

## 1.6 Task 6

The hospital subsystem (module) for patient admission supports the selected a fraction of the duties performed in the hospital by the receptor. The receptor, through the mentioned subsystem, performs patient ordering and plans the admission of patients to the hospital. The receptionist collects information about the patient by telephone and / or upon the patient's arrival at the hospital (when the patient is admitted to the hospital) and thus registers the patient on the basis of the collected information. The patient can be admitted to the hospital as an internal patient, which means that he stays in the hospital and is therefore assigned a bed. The patient can also be admitted to the hospital as a so-called external patient, which means only a daily visit to a specialist. The receptionist can also accept patient payments for self-pay services, which he records in a database, provides prescriptions, and posts both patient insurance data and medical records. Using the **UML use case diagram**, describe the described module - receptor functionalities in the hospital office reception.

## 1.7 Task 7

Use **the state machine diagram** to describe how the online store works. You ordered a basket of five items in the online store a week ago and are still waiting for delivery. You are furious that you have decided to investigate how the system of sending items to the online store works. When the customer completes and places the order, the system starts the process of shipping and sending the purchased items, which works as follows: First, the system checks each item individually in order to see if it is in stock and ready to ship. If all items are in stock, the system switches to sending packages. If any of the items are not in stock, the system waits and delivers the items until all the items are in stock. When all items of the order are delivered (in stock), the system switches to sending the purchased products. In any of the system states, the customer can cancel the order until the items are shipped. After sending the shipment, the customer can no longer cancel the order and the package is delivered to the customer's address.

## 1.8 Task 8

In this task, it is necessary to model the basic functionality of mobile phones, namely a phone call, and the use of the phone book. The mobile phone user can call, answer a call, add a new contact or search the phonebook of stored phone numbers. The phonebook search function also includes so-called entry management, where the user can edit an entry, delete an entry or make contact with the selected entry. Making a contact can be a call or a message. For the example above, draw a **use case diagram**!

## 1.9 Task 9

You recently decided it would be time to replace your old car with a new steel horse. In the desire to buy a better car, despite the proceeds from the sale of the old one, and your savings, you sadly find that without taking out a loan, it will not work. To do this, go to the bank for a loan. At the bank, you ask the loan agent for a loan application form, which is kindly handed to you by the agent. Carefully review and complete the form and submit it to the agent. The agent initiates a check of your creditworthiness through IS Bank, and in a few moments he receives information about it. Since the amount of credit you want to take out is quite high, the agent checks your current

payment obligations through a unified system for checking your financial operations. It depends on both the creditworthiness and the detailed review of the business whether you get an approved or rejected loan application from the agent. For the above loan example, draw a **sequence diagram**!

### 1.10 Task 10

In this task, we will look at the operation of the basic functionality mobile phones, namely a telephone call. After switching on, the mobile phone waits most of the time either for the user's action or for receiving a call. The moment the phone rings it waits for the user to respond. If there is no response, the phone returns to its original state. If the user answers the call while ringing, a call session is established and the conversation begins. When the user or caller ends the call, the phone returns to standby. In addition to the above, the user can also call with the phone by entering the desired phone number and pressing the call button. When the call is completed, the mobile phone returns to its original state. For the example above, draw a **state machine diagram**!

### 1.11 Task 11

In this assignment you have to model the basic functionality of mobile phones, which is phone call, and use of a phone book. Mobile phone user can place a call, receive a call, add new contact or search a Phone book. The function Search phone book also includes the so-called Entry manipulations, where the user can edit an entry, delete contact or establish contact with the selected entry. Contact function might be placing a call or sending a message. For the example above, draw the **UML use case diagram**!

### 1.12 Task 12

Recently you've decided that it's time to replace your old car with a new one. In order to purchase a better car in spite of the proceeds from the sale of the old one, and your savings, you sadly find out that it won't work without taking a loan. So at the end you go to a bank for loan. In the Bank, you as an Applicant ask Loan Agent for the Loan Application. Agent friendly handed you the application form. You carefully read, fill out and finally hand over the application to the agent. Agent runs a credit check to the Credit Agency and in a few moments gets a credit score report. Because of the high amount of loan that you are trying to get, the agent runs a Background check to the Verification agency in order to verify additional information about your former financial management. Both, the credit score and the background check depends on whether an agent decides your loan gets approved or declined and then gives you an answer. For the example above, draw the **UML sequence diagram**!

### 1.13 Task 13

In this assignment you have to model the basic functionality of mobile phones, which is a phone call. After being powered on, a mobile phone is most of the time in its primary mode in which it's either waiting for the action of a user or waiting for the incoming call. The moment the phone rings it goes to a waiting for a user response mode. If there is no response from the user the phone is restored to its original state. If the phone rings and the user answers to the call, a dial-up session is established and a conversation mode is started. When a user or caller terminates the conversation the phone returns to its original state. In addition to this, a user can also place a call, as he enters

the desired telephone number and presses the call button. At the termination of the call, the mobile phone again returns to its original state. For the above example, draw the **UML state diagram**!

### 1.14 Task 14

The operation of the heating controller with solar collectors has the following properties: When switched on, the system is initialized, switching on the flow pump for 60 minutes and monitoring the tank temperature ( $T_r$ ) and collectors ( $T_k$ ) with temperature sensors. If the temperature difference  $T_k - T_r \geq 10^\circ \text{C}$ , it starts heating the tank with the flow pump switched on. When the temperature difference falls below  $4^\circ \text{C}$ , the system enters sleep mode. Heating also ends if the maximum tank temperature is exceeded. In winter conditions, the controller takes care to prevent the collectors from freezing, which happens when the temperature  $T_k$  falls below the set limit temperature of the transmission medium. Then the system starts the flow pump for 15 minutes, thus heating the collectors with warmer water through the tank. If an additional heating source is connected to the tank and tubular flow collectors are used, the controller also takes care of cooling in the event of overheating of the system. This happens when the upper limit temperature of the tank is exceeded and at the same time the temperature of the collectors is lower than it. In this case, the controller switches on the flow pump. If the controller detects a malfunction at any time, for example when reading sensor temperatures, it enters an error state where it switches off all activities for 15 minutes. After this time, it tries to restore operation by the initialization process. It presents the operation of the described controller with a **UML state machine diagram**.

### 1.15 Task 15

The web application "glazek.si" offers individuals the following options: search for inns by name, location and offer, view the presentation of the selected inn, reservation and cancellation of reservations (required entry of personal data in the web application, reservations are confirmed by inns via SMS). Use the **sequence diagram** to show the process of booking dinner for two at the Podluno inn!

### 1.16 Task 16

Suggest with a **UML diagram of a use case** functionality of the wireless Internet connection sharing system. The basic idea is that owners of wireless access points (WiFi) can open their network to other users, thus gaining the opportunity to access the Internet through access points of other users. Each user should be able to review the use of their access point. The entire system should be controlled by the system administrator, who has access to all system data and can resolve reports of abuse. Each example of use shown in the diagram is briefly explained (at least one sentence with a basic description).

## 2 Exams

### 2.1 Task 17

The bicycle rental information system has the following functionality:

- The system allows bike rental staff to keep bicycle records. Purchases, loans, returns, servicing, sales, losses and write-offs of bicycles are recorded.
- The system supports customer business. It enables the customer to book a bicycle rental via the built-in portal, and enables the staff of the rental company to prepare a contract for the rental of bicycles, as well as the return of certificates for the return of bicycles. At the same time, the rental staff can update customer data.
- The system enables the management of the rental shop to easily manage the pricing policy of renting bicycles in terms of determining prices according to the type of bicycle and special offers.
- The system provides the management of the rental company with an easy insight into the operations of the rental company (the scope of the loan depending on the type of bicycles, the time and duration of the loan, the borrower and the customer).

Create a **UML use case diagram**!

## 2.2 Task 18

The food delivery restaurant wants to order and deliver food supported by a software solution. They want the following functionality:

- The user can place an order electronically (from the Internet or an application on a mobile phone) or by telephone (order information is entered by user support).
- A user who places an order electronically can log in to the system, which allows him to store delivery locations.
- The choice of location for delivery is supported by a map in the software solution and allows the use of GPS, which enables delivery to any location (not only to postal addresses). An order for a location that is not in the range of possible delivery is automatically rejected.
- The software solution provides the user with an insight into the menu for easy food selection.
- The user's order is received by the restaurant's kitchen, which hands over the food to the delivery service upon completion of the order.
- The program optimizes food delivery by selecting the most suitable delivery person according to location and time.
- Registered users can monitor the status of their order.
- The software solution facilitates delivery to the delivery person by displaying the location on a map, and at the same time takes care of issuing invoices.
- In case of late food delivery, a discount is charged to the customer.

For the described software product, make a **UML use case diagram**!

### 2.3 Task 19

The restaurant with food delivery wants to support ordering and food delivery with a software solution. They want the following functionality:

- The user can place an order electronically (from the Internet or an application on a mobile phone) or by telephone (order information is entered by user support).
- A user who places an order electronically can log in to the system, which allows him to store delivery locations.
- The choice of location for delivery is supported by a map in the software solution and allows the use of GPS, which enables delivery to any location (not only to postal addresses). An order for a location that is not in the range of possible delivery is automatically rejected.
- The software solution provides the user with an insight into the menu for easy food selection.
- The user's order is received by the restaurant's kitchen, which hands over the food to the delivery service upon completion of the order.
- The program optimizes food delivery by selecting the most suitable delivery person according to location and time.
- Registered users can monitor the status of their order.
- The software solution facilitates delivery to the delivery person by displaying the location on a map, and at the same time takes care of issuing invoices.
- In case of late food delivery, a discount is charged to the customer.

For the described software product, create a **UML state machine diagram**!

### 2.4 Task 20

The mail management software offers two ways to send mail: Sending mail with a stamp, where the customer can buy a stamp from the employee at the post office counter, whereby the software product keeps records of the number of stamps in stock and takes care of automatic ordering of new stamps when the stock of stamps is below the set limit. Postage with the stamp is delivered by the customer to the mailbox. - Sending registered items, where the postal employee places the item on the scales, and the software product prepares a delivery order and a confirmation for the customer. The shipment is then picked up by a postal employee. Draw a **UML use case diagram** for the described software product!

### 2.5 Task 21

The vehicle reservation system via the online application allows you to the customer reserves the vehicle rental. The system includes several rental providers who have their own vehicle records. The booking process consists of the following steps:

- Allows the user to select the time and location of collection and the time and location of vehicle return.

- The server sends queries to several providers and, based on the returned information, offers the user a list of available cars.
- The user can select a car for which the system displays price and provider information.
- When the user confirms the choice of car, the system prompts him to enter his personal data (name and surname, address, driver's license number, telephone number, confirmation e-mail,...).
- The system offers the customer a choice of additional options (additional vehicle insurance and accident insurance for the rental period) and invites the customer to determine whether to accept or reject each of the offered options. The customer answers YES or NO with each option.
- The booking process ends with a review and confirmation of the booking. If the customer agrees, the reservation is saved, forwarded to the loan provider and the user is notified of the reservation by e-mail.

Draw a **UML sequence diagram** for the described system!

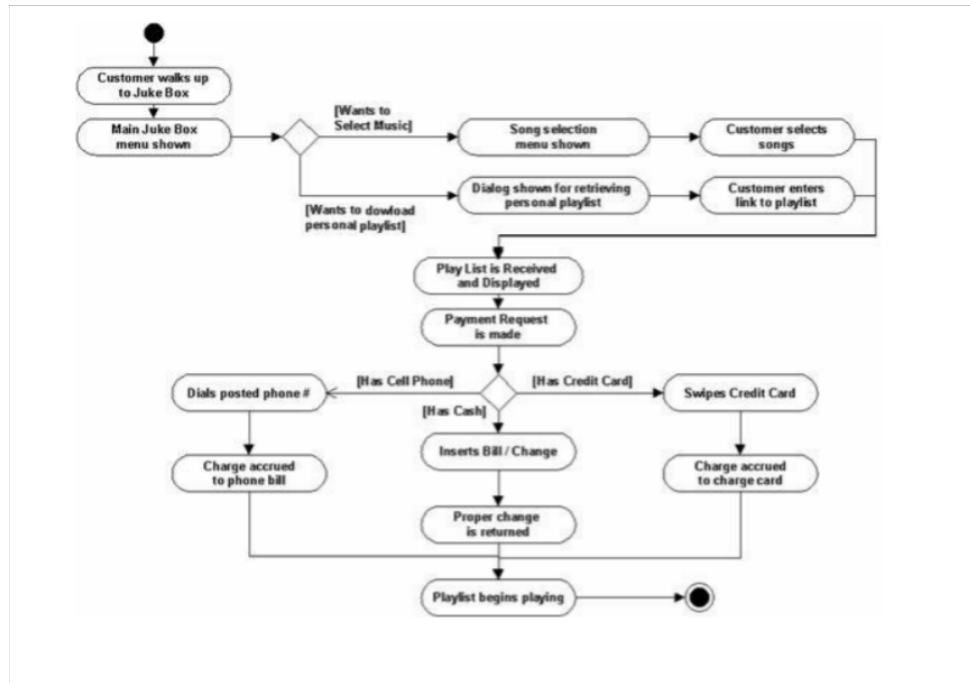


## 3 Midterm 2

### 3.1 Task 1

Determine the cyclomatic complexity and basic pathways for a system with a given activity diagram!

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### 3.2 Task 2

Defines test cases for the function that checks the correctness of EMŠO (unique personal identification numbers of the citizen)! Explain the choice of test cases (indicate the testing techniques used)!

### 3.3 Task 3

Determine the cyclomatic complexity for a given function and suggest test cases based on the determination of basic pathways.

```
int myfact (int n) { int i=0, fact=1; if(n<=1) { return(1); } else { for(i=1;i<=n;i++) { fact=fact*i; if (fact>255) { return (0); } } return(fact); }
```

### 3.4 Task 3

The modern autonomous vehicle is capable of driving independently on the road without interacting with the driver. Part of the vehicle control system is also an automatic transmission control application that changes gears based on acceleration and braking data, based on engine speed. The following laws apply to the automatic transmission of an autonomous vehicle:

- The maximum speed of the petrol engine is 9,000 RPM, with a maximum speed of 7,000 RPM and an optimum speed of 3,500 RPM.
- In addition to the number of revolutions, the gearshift application is also changed on the basis of road inclination data, maintaining a one-step lower gear than calculated for a carriageway slope of more than  $\pm 10\%$  and shifting or maintaining the gear in first gear for  $\pm 20\%$  inclination.
- In case of errors, the function returns an exception with a description of the error.

Suggest test cases if it's a 5-speed automatic transmission with the car shifting into a higher gear at 5,000 and a lower one at 2,500! Justify the choice of test cases!

### 3.5 Task 4

Determine the cyclomatic complexity, basic pathways for a given function and suggest test cases based on the latter.

```
void foo (float y, float *a, int n)
{
    float x = y * n;
    if (x > 0.01)
        z = tan (x);
    else
        z = cos (x);
    for (int i = 0 ; i < MAX ; ++i)
    {
        a[i] = a[i] * z;
        [i];
    }
}
```

### 3.6 Task 5

Determine the cyclomatic complexity, basic pathways for a given function and suggest test cases based on the latter.

```
int fibonacci(n) {
    int n, c, first=0, second=1, next;
    for (c=0 ; c<n ; c++)
        if (c <= 1)
            next=c;
        else {
            next=first+second;
            first=second;
            second=next;
        }
    return next;
}
```

### 3.7 Task 6

Suggest test cases for the web application login page. The login is based on the username or e-mail address and the user's password. Even if the app's web pages are not protected by a secure connection, the user's login must be secure. After five failed logins, the user must be prevented from logging in for 5 minutes, and a warning about failed logins and instructions for resetting the password must be sent to his e-mail address. Indicate which test method you used to determine the test cases!

### 3.8 Task 7

For the given function, draw a graph of the control flow, determine (calculate) the cyclomatic complexity, list all the independent paths and suggest test cases:

```
int main()
{
    int n, reverse = 0, temp;

    printf("Enter a number to check if it is a palindrome or not\n");
    scanf("%d",&n);

    temp = n;

    while( temp != 0 )
    {
        reverse = reverse * 10;
        reverse = reverse + temp%10;
        temp = temp/10;
    }

    if ( n == reverse )
        printf("%d is a palindrome number.\n", n);
    else
        printf("%d is not a palindrome number.\n", n);

    return 0;
}
```

### 3.9 Task 8

We want to check the operation of the function, which is intended to find the intersection of two planes. The input parameter of the function are two vectors, each consisting of three nonlinear points defining a plane. As a result, the function returns a cross-section vector consisting of a minimum number of points that uniquely define the cross-section. In the event of an error, the function returns an exception. The point is always represented by integer values for x, y and by a coordinate. Suggest test cases that will check the proper functioning of the function and also explain the proposed test cases (state the testing principles used)!

### 3.10 Task 9

For the given function draw down a control flow graph, determine (calculate) a cyclomatic complexity, write down all independent paths and suggest test cases:

### 3.11 Task 10

We want to evaluate a function, which is aimed at finding intersection of two planes. Input parameter features two vectors, each composed of three noncollinear points that define a plane. As a result, the function returns a vector of cross-section, which consists of a minimum number of points to uniquely define the cross-section. In case of an error the function returns an exception. A point is always represented with integer values for x, y and z coordinate. Suggest the test cases to verify correct operation of the function and explain them (name the testing principles used)!

```

int main()
{
    int n, reverse = 0, temp;

    printf("Enter a number to check if it is a palindrome or not\n");
    scanf("%d",&n);

    temp = n;

    while( temp != 0 )
    {
        reverse = reverse * 10;
        reverse = reverse + temp%10;
        temp = temp/10;
    }

    if ( n == reverse )
        printf("%d is a palindrome number.\n", n);
    else
        printf("%d is not a palindrome number.\n", n);

    return 0;
}

```

### 3.12 Task 11

Suggest a set of program classes to describe the card game Black Peter. Draw a UML class diagram for the proposed solution. Game description: The set of cards has 29 cards, all except the "Black Peter" card are in pairs. The shuffled cards are evenly distributed among all players. If a player gets two identical cards (pair), he can put them aside. Clockwise, players draw cards from previous players and whenever they have a pair, they can place both cards on the table (cards go out of play). The player who runs out of cards first wins.

### 3.13 Task 12

For the given function, draw a graph of the control flow, determine the cyclomatic complexity, list all the independent paths and suggest test cases:

### 3.14 Task 13

We want to check the operation of the function which, for the plane determined by the parameters (a, b, c, d) of the equation  $ax + by + cz - d = 0$ , checks where it intersects the z-axis of space. Depending on the value of z, the function should return the following output values:

$$0; z < 0.1; z = 0.2; z > 0, -1;$$

the plane does not intersect with the coordinate axis. Suggest test cases that will check the correct operation of the function and also explain the proposed test cases (state the testing principles used)!

### 3.15 Task 14

For the given function, which should print all primes for a given number, draw a graph of the control current, determine the cyclomatic complexity, print all independent paths and suggest test cases:

```

/* Check if a number is a perfect number:
Perfect number is a positive number which sum of all
positive divisors excluding that number.
For example 6 is Perfect Number since divisor of 6 are 1, 2
and 3. Sum of its divisor is 1 + 2+ 3 =6
*/

#include<iostream.h>
#include<conio.h>
void main()
{
    int i;
    cin >> i;
    clrscr();
    int u=1, sum=0;
    while(u<i) {
        if(i%u==0 )
            sum=sum+u;
        u++;
    }
    if(sum==i) {
        cout<<i<<" is a perfect number."<<"\n";
    }
    u=1;

    getch();
}

```

### 3.16 Task 15

Test cases: Pizzeria "Pri FAMNITu" wants to offer online ordering. The online ordering form therefore provides an input field where users specify the number of pizzas ordered. However, the number of pizzas ordered is limited to:

- only orders of 1-10 pics are allowed and in this case the user is notified of a successful order
- if the number of ordered pizzas is between 11 and 99, the user will be notified that a maximum of 10 pizzas can be ordered and
- If the entered text exceeds three characters, the user is notified of the invalid entry.

Suggest test examples that will check the correct operation of the input field and state the principles of testing used and the reasons for their selection!

### 3.17 Task 16

We want to check the operation of the function that calculates the polar angle (corresponding to the angle in the polar coordinate system) on the basis of the given Cartesian coordinates X and Y. Results must be given in angular degrees and in the range of -180 to 180 degrees. Suggest test cases and justify them! What kind of testing is it? Also indicate the procedure used to determine the test cases!

```

// Program to print all prime factors
# include <stdio.h>
# include <math.h>

// A function to print all prime factors of a given number n
void primeFactors(int n)
{
    // Print the number of 2s that divide n
    while (n%2 == 0)
    {
        printf("%d ", 2);
        n = n/2;
    }

    // n must be odd at this point. So we can skip
    // one element (Note i = i +2)
    for (int i = 3; i <= sqrt(n); i = i+2)
    {
        // While i divides n, print i and divide n
        while (n%i == 0)
        {
            printf("%d ", i);
            n = n/i;
        }
    }

    // This condition is to handle the case when n
    // is a prime number greater than 2
    if (n > 2)
        printf ("%d ", n);
}

```

### 3.18 Task 17

Determine the cyclomatic complexity for a given function and suggest test cases:

```

myFunction( int i, int j ) {
    if ( i>0 && j>0 ) {
        while ( i>j ) {
            if ( i%2 && j % 2)
                print( "%d\n", i );
            else
                print ("%d\n", j );
            i--;
        }
    }
}

```

### 3.19 Task 18

Determine the cyclomatic complexity for a given function and suggest test cases:

```

int factorial( int n )
{
    if ( n <= 1 )
        return 1;
    else
        return n * factorial( n-1 );
}

```

### 3.20 Task 19

Suggest test examples for testing the function for calculating the area of a triangle given by the lengths of sides a, b, and c. If the specified side lengths do not specify a triangle, the function must return a value of -1. Justify the proposed test cases!