

## Programming Project, Database Technology

The programming project is compulsory. You are supposed to work in groups of two or three people, and it is up to you to find group partners. If you have difficulties finding a group partner, send an e-mail to `Per.Holm@cs.lth.se`.

You shall describe your results in a written report. If the report doesn't receive a "passed" grade, it must be corrected and resubmitted. See section 5 for details on how to submit the report and your programs.

The project consists of three parts: database modeling, database implementation, and development of (parts of) a user interface to the database.

If you want to make certain that you are going in the right direction in your solution, you may hand in a description of your database model. The description should be sent as a *pdf* file to `Per.Holm@cs.lth.se`. We will check your model and give comments and, if necessary, suggest corrections or improvements. The description need only consist of a sheet with an E/R diagram and the resulting (normalized) relations. You will receive comments on your model via e-mail.

Questions about the project can be directed to Per Holm (`Per.Holm@cs.lth.se`).



# 1 Assignment

## Introduction

You shall model and implement a database for the supervision of production and delivery of cookies produced by the company Krusty Kookies Sweden AB. The company and its routines for production and delivery are presented in section 2. The requirements for the database and for the interface to the database are presented in section 3. In section 4 you will find modifications of the requirements, suitable for the pilot implementation that you are to perform.

Notice that the text in sections 2 and 3 is written by the company. This may have had the consequences that some of the requirements are in the section containing the company presentation, and also that some text in the requirements section is company promotional material. An analysis of the requirements is part of the assignment. You shall make reasonable assumptions where the description is unclear.

## Modeling

Produce a complete database description with an E/R diagram and a relational model. You may, if you wish, hand in this description for comments (see the cover sheet).

## Implementation of the Database

Implement the database. Document and justify any deviations from the model.

## Implementation of the User Interface

Implement a graphical user interface to the database (only “program 2” of the programs mentioned in section 4).

- All requirements must be addressed.
- The implementation must be stable. The system should produce reasonable results for arbitrary input.
- The user interface must be self-explanatory and easy to use.

## Alternative Implementations

One implementation alternative is to use the department’s MySQL system and write a Java application that communicates with the database with JDBC calls and uses Swing for the graphical user interface, as you did in lab 3. You will probably be able to use the GUI classes that you used in lab 3, suitably modified. Another alternative is to use PHP as in lab 4.

However, we do not require that you use this method of implementation. You may use a different database system (PostgreSQL, ...), you may use a different programming language (C, C++, Visual Basic, ...), you may use another form of interface (developed in JBuilder, web pages with Perl, servlets, JSP, ASP, ...).

Two requirements are non-negotiable: 1) your database must use “normal” SQL that you write by yourselves (so Microsoft Access is not allowed), and 2) it must be possible to test your programs at a computer, connected to the Internet, in the E building. As an alternative you may develop the entire system on your own computer, but then you must bring a laptop computer to the department to demonstrate your program.

If you plan to use some exotic combination of database and interface implementation and are not sure how to interpret the requirements, you should ask before you start programming.

## Report

The report should be written in English (you may write in Swedish if you absolutely cannot produce readable English). Contents:

1. A cover sheet with the name of the project, your names, education programs, and e-mail addresses. You must check mail to these addresses regularly.  
Also give the date of submission and complete instructions for running your program.
2. An introduction (what the project is about, etc.).
3. Something about requirements that you fulfill or don't fulfill.
4. An outline of your system (which database manager you use, which programs you have written, how the programs communicate with the database, etc.).
5. An E/R diagram which describes the system.
6. Relations. Indicate primary keys, possibly secondary keys, and foreign keys. You must show that the relations are normalized according to your chosen normal form (if a relation "obviously" is in BCNF you may say so, provided that you justify your statement). If a relation is in a lower normal form than BCNF, you must justify this choice.
7. SQL statements to create all tables, views, stored procedures, and other database elements. (Don't include statements to create the initial contents of the database.)
8. A user's manual (not necessary if everything in the program is self-explanatory).

## 2 Krusty Kookies Sweden AB

### Company Presentation

Krusty Kookies Sweden AB is the new name for the company earlier called Småkakor AB. We changed our name when we were taken over by the multi-national company Krusty Kookies. Our business idea is, as it always has been, to provide our customers with a broad range of high-quality cookies, and the unique production and delivery concept developed by Krusty Kookies will allow us to meet our goals.

Krusty Kookies gives us the opportunity for new investments that will increase customer satisfaction with our products. We will introduce a new production line in the bakery, and the routines for storage management will be updated. This will increase our production capacity and make a diversification of our product range possible, and will enable us to reach new groups of customers.

### A Computerized System for Production and Delivery

Earlier, we used manual routines for planning and follow-up of production and delivery. This worked well in the small scale in which we used to work, but since the scope of our operations has widened we plan to use computerized routines. One of the basic ideas of Krusty Kookies is to take geographic and national differences into account, so the system will be developed locally in Sweden.

The computerized system must be flexible and be able to meet our demands on usability and reliability. In the following sections we describe how production and delivery will function in our new production plants. In section 3 you will find detailed requirements on the system.

In the prototype implementation, the simulated production and customer data in appendices A–B shall be used.

### Production and Packaging

Our raw materials warehouse contains all ingredients that are necessary for our different products. We will continue to use our well-proven manual routines to order raw materials, so it can be

assumed that all necessary ingredients are present in sufficient quantities for the production of the desired products.

Cookies are baked in our new ovens, following our traditional and proven recipes (appendix A). Each type of cookie is baked in large quantities. The cookies are quick frozen and packaged in bags, with 15 cookies in each bag. The bags are put in boxes, with 10 bags in each box.

The boxes are stacked on loading pallets, which are shrink-wrapped in plastic and labeled with bar code labels. Each pallet contains 36 boxes, all containing the same product. It takes 10 minutes to produce and load a pallet of cookies. This impressive speed is due to our new mixers and ovens, which use the latest advances in bakery technology.

Appendix C shows a sketch depicting the production process, and also storage and delivery.

## **Storage**

When a pallet is produced and labeled, it is transported to the deep-freeze storeroom. When the pallet reaches the storeroom the pallet label is read by a bar code reader.

## **Orders**

Customers place their orders through a web form or by telephone. All customers (appendix B) must be registered in our database (we have special routines for checking and registering customers). Orders are of the type “send 10 pallets of Tango cookies and 6 pallets of Berliners on Thursday next week”. We only deliver full pallets.

## **Loading**

Pallets are transported from the deep-freeze storeroom via a loading ramp to the freezer trucks. Each truck loads 60 pallets. The entry to the loading ramp contains a bar code reader which reads the pallet label. Pallets must be loaded in production date order. The time to load a pallet is approximately one minute.

When the truck is fully loaded, the driver receives a loading bill containing customer names, addresses, and the number of pallets of each product that is to be delivered to each customer. A transport may contain deliveries intended for different customers.

We deliver only to wholesale customers (appendix B). We again point out that this data is simulated — the number of customers will increase considerably in the near future. We are also planning to expand our market to all of Scandinavia.

In the future, the data from the delivery system will be integrated with our existing invoicing system.

## **Quality Assessment**

In order to guarantee high product quality we continuously take random samples among the products. The samples are analyzed in our laboratory. If a sample doesn't meet our quality standards, all pallets containing that product that have been produced during a specific time interval are blocked. A blocked pallet may not be delivered to customers.

# **3 System Requirements**

## **Production**

A pallet is considered to be produced when the pallet label is read at the entrance to the deep-freeze storage. The pallet number, product name, and date and time of production is registered in the database. The pallet number is unique.

At any time, we must be able to check how many pallets of a product that have been produced during a specific time.

## Raw Materials

When a pallet is produced, the raw materials storage must be updated. We must be able to check the amount in store of each ingredient, and to see when, and how much of, an ingredient was last delivered into storage.

## Recipes

We need an interface to the collection of recipes (appendix A), where we can study and update recipes. We also need a facility for entering new recipes. We don't change recipes during production.

## Produced Pallets

As we mentioned earlier, pallets in the deep-freeze storage may be blocked. An order to block a pallet will always come before the pallet has been delivered. This is due to the new investments in our laboratory, where the analysis process is completely automated.

We must be able to trace each pallet. For instance, we need to see all information about a pallet with a given number (the contents of the pallet, the location of the pallet, if the pallet is delivered and in that case to whom, etc.). We must also be able to see which pallets that contain a certain product and which pallets that have been produced during a certain time interval.

Blocked products are of special interest. We need to find out which products that are blocked, and also which pallets that contain a certain blocked product.

Finally, we must be able to check which pallets that have been delivered to a given customer, and the date and time of delivery.

## Orders and Production Planning

Orders must be registered in the database. For production planning purposes, we must have a facility to see all orders that are to be delivered during a specific time period.

The production planning is manual. At the end of each week, production for the following week is planned, using the orders for the following weeks as input. We cannot produce "on demand", since it takes time to set up a production line for a new kind of cookie (mixers have to be cleaned, for example).

## Delivery

Before pallets are loaded into the freezer trucks, a loading order is created. The order contains information regarding the customers and the number of pallets to be delivered.

When pallets are taken out of deep-freeze storage the pallet label is read. When the truck is loaded, the driver receives a loading bill (identical to the loading order, but contains a field where the customer can acknowledge reception of the delivery). The loading bill data need not be saved in the database.

When the loading bill has been printed, the data regarding delivered pallets must be updated with customer data and date of delivery.

## 4 Introductory Study

Here, the results of an introductory study of the project are given. We have studied the requirements specification and made decisions regarding the pilot implementation:

- We must be able to test the system without connecting it to the factory. For instance, we do not have access to the bar code readers that inform us about pallet production or pallet delivery. Instead, we introduce a screen in the user interface where we simulate pallet

production and another screen where we simulate pallet delivery. These screens will be removed from the production version of the system. The decision means that we can ignore all information about production and delivery speed.

- The database must be correct and we must be able to check all different cases, so we implement the entire database.
- The requirements specification mentions “the program” that interfaces to the database, but the company has informed us that different departments will use different parts of the program. Therefore, the system will be better if each department only can see the part of the database that concerns them. We will write three different programs that use the same database:
  1. One program that handles everything that concerns raw materials and recipes.
  2. One program that handles everything that concerns production,<sup>1</sup> blocking and searching of pallets. The test version of this program will incorporate the screen where pallet production is simulated.
  3. One program that handles everything that concerns orders and deliveries.
- In the pilot implementation we only implement the program mentioned under item 2 above. When we show the system to the customer, we make sure that the database contains relevant data so we can demonstrate all of the functionality (we will use `mysql` or a similar client program to enter the data).

## 5 Submission of Results

The latest date for submission is in the course plan. When you are ready to submit your report and your programs, do the following:

1. Produce a *pdf* file of your report. Write a *README* text file with detailed instructions on how to test your system.
2. E-mail these files to `eda216@cs.lth.se`. The subject line of the e-mail should be (for a group with two people):

`krusty by id1 id2`

`by` is a necessary delimiter. `id1` and `id2` are your student id’s (the ones that you used when you signed up for the labs). Write your full names in the letter.

3. Include any other files that we need to test your system. Examples:
  - You use MySQL at `puccini.cs.lth.se`, you have written the interface program in Java: include all your Java classes (*zip* or *tar.gz* format).
  - You use MySQL at `puccini.cs.lth.se`, you have written PHP programs for the interface: include the directory *phproot* that contains your programs and HTML files (*zip* or *tar.gz*).
  - You use a web interface to your own web server: don’t include anything, just give the URL in the *README* file.
  - You have the whole system on your own laptop: don’t include anything, just say this in the *README* file. We will contact you via e-mail to find a time for a meeting where you can demonstrate your system.

<sup>1</sup> Production includes updating the raw materials storage when a pallet is produced.

## Appendix A. Products

The table below contains recipes for some of our traditional products. Each recipe is for 100 cookies.

<i>Nut ring</i>	Flour	450 g
	Butter	450 g
	Icing sugar	190 g
	Roasted, chopped nuts	225 g
<i>Nut cookie</i>	Fine-ground nuts	750 g
	Ground, roasted nuts	625 g
	Bread crumbs	125 g
	Sugar	375 g
	Egg whites	3,5 dl
	Chocolate	50 g
<i>Ammeris</i>	Marzipan	750 g
	Butter	250 g
	Eggs	250 g
	Potato starch	25 g
	Wheat flour	25 g
<i>Tango</i>	Butter	200 g
	Sugar	250 g
	Flour	300 g
	Sodium bicarbonate	4 g
	Vanilla	2 g
<i>Almond delight</i>	Butter	400 g
	Sugar	270 g
	Chopped almonds	279 g
	Flour	400 g
	Cinnamon	10 g
<i>Berliner</i>	Flour	350 g
	Butter	250 g
	Icing sugar	100 g
	Eggs	50 g
	Vanilla sugar	5 g
	Chocolate	50 g



## Appendix B. Customers

The table shows some of our customers (wholesalers).

Customer	Address
Finkakor AB	Helsingborg
Småbröd AB	Malmö
Kaffebröd AB	Landskrona
Bjudkakor AB	Ystad
Kalaskakor AB	Trelleborg
Partykakor AB	Kristianstad
Gästkakor AB	Hässleholm
Skånekakor AB	Perstorp

## Appendix C. Production, Storage, and Delivery

