

Use the B method to specify a system capable of handling invoices for customers in a commercial environment. The system has to manage the following entities: *client*, *product*, *invoice* and *line* of invoice. Next, there is a brief description of each of them:

- A *client* is recorded in the system together with its *category* (*normal*, *dubious* or *friend*) and also with its maximum *allowance*, which is a certain amount of money that cannot be exceeded in any invoice issued to that client. To each category of clients there corresponds a certain *discount* applicable to the corresponding invoices.
- A *product* is recorded together with its *price*, its *status* (*available* or *sold out*) and its possible *substitute* (if any), which is another product guaranteed not to be itself sold out.
- An *invoice* is first concerned with the *client* to whom it is issued. An invoice also has a *discount* represented by a certain *percentage* to be applied to the total of the invoice. Finally, an invoice is characterized by the maximum amount of money that is *allowed* to it. These two attributes of an invoice (*percentage* and amount *allowed*) are taken originally (when the invoice is created) from similar attributes of the client (*discount* and *allowance*).
- Each *line* of an invoice is concerned with a certain *article*, the *quantity* of that article, and its *unit cost*. This last attribute of an invoice is taken originally (when the invoice is created) from the *price* attribute of the article.

The system should provide a number of operations for creating and modifying a client, for creating and modifying a product, for creating and destroying an invoice, and, finally, for adding a new line to an invoice. Next, there are a number of informally stated laws that the system should satisfy:

1. A sold out product cannot be part of an invoice.
2. However, if there is a substitute for the sold out product, then the system must automatically replace, in the invoice, the product in question with the substitute.
3. No two distinct lines of the same invoice may correspond to the same article.
4. No invoice should be made for dubious clients.
5. The (discounted) total of an invoice must not be greater than the maximum amount of money allowed for that invoice.
6. Friend clients get a 20% discount, whereas other clients get no discount at all.

The specification should be realized and verified for consistency within AtelierB. All components must pass type-checking. It is not required to prove all proof obligations, but those not automatically proved should be analyzed for validity.