BCS2213 – Formal methods

Teaching assignment 1. Z specification of BirthdayBook**.**

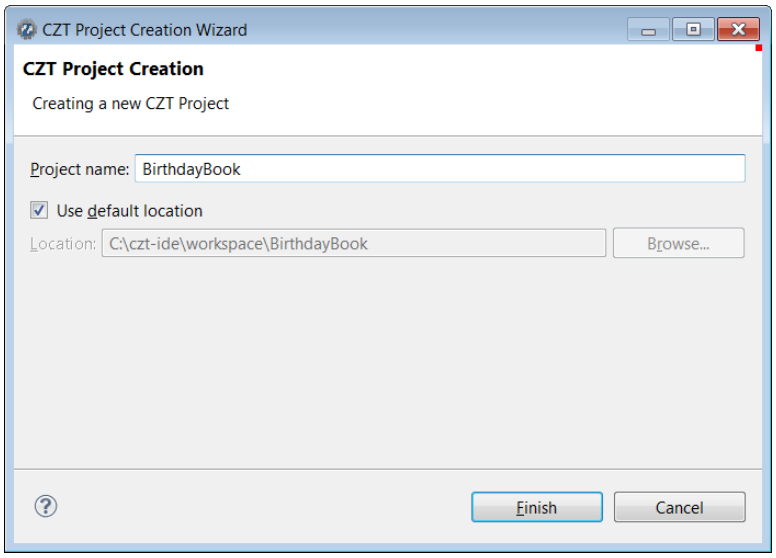
1. Run CZT-IDE.

   The Community Z Tools (CZT) is a set of tools for editing and typechecking formal specifications written in Z specification language.

   Note, if CZT-IDE is not installed on your PC you may download it from http://sourceforge.net/projects/czt/files/czt-ide/2.0-pre1/

2. Creating a CZT project.

   Create a new CZT project by selecting **File > New > Project > CZT > CZT Project** in the menu.



- Enter the name of the new project.

Note: you can create CZT project in your existing directories: just specify an existing directory in the Location field. The name does not have to match the directory.

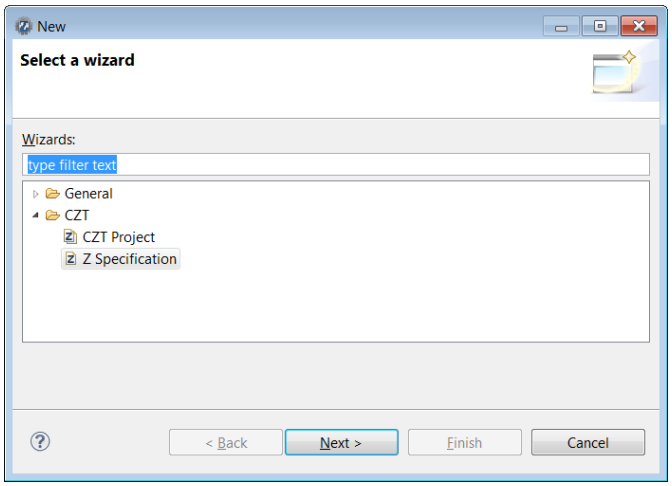
- If the **Z perspective** is not active at the moment, the wizard will ask you whether you want to open the Z perspective. It is highly recommended that you open it because it will automatically open a set of Eclipse views useful for Z development.
- The new project will be created and selected in the workbench window.

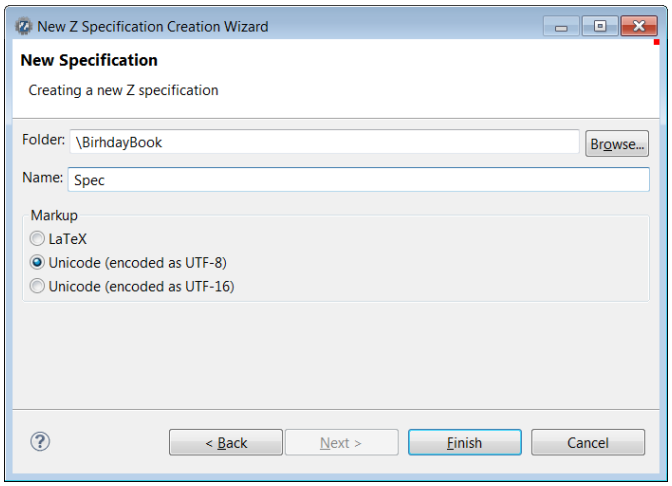
3. Creating Z specification.

   The CZT editor plug-in provides a wizard to create a new Z specification. The wizard can be opened using the menu entry **File > New > Other… > CZT > Z Specification**.

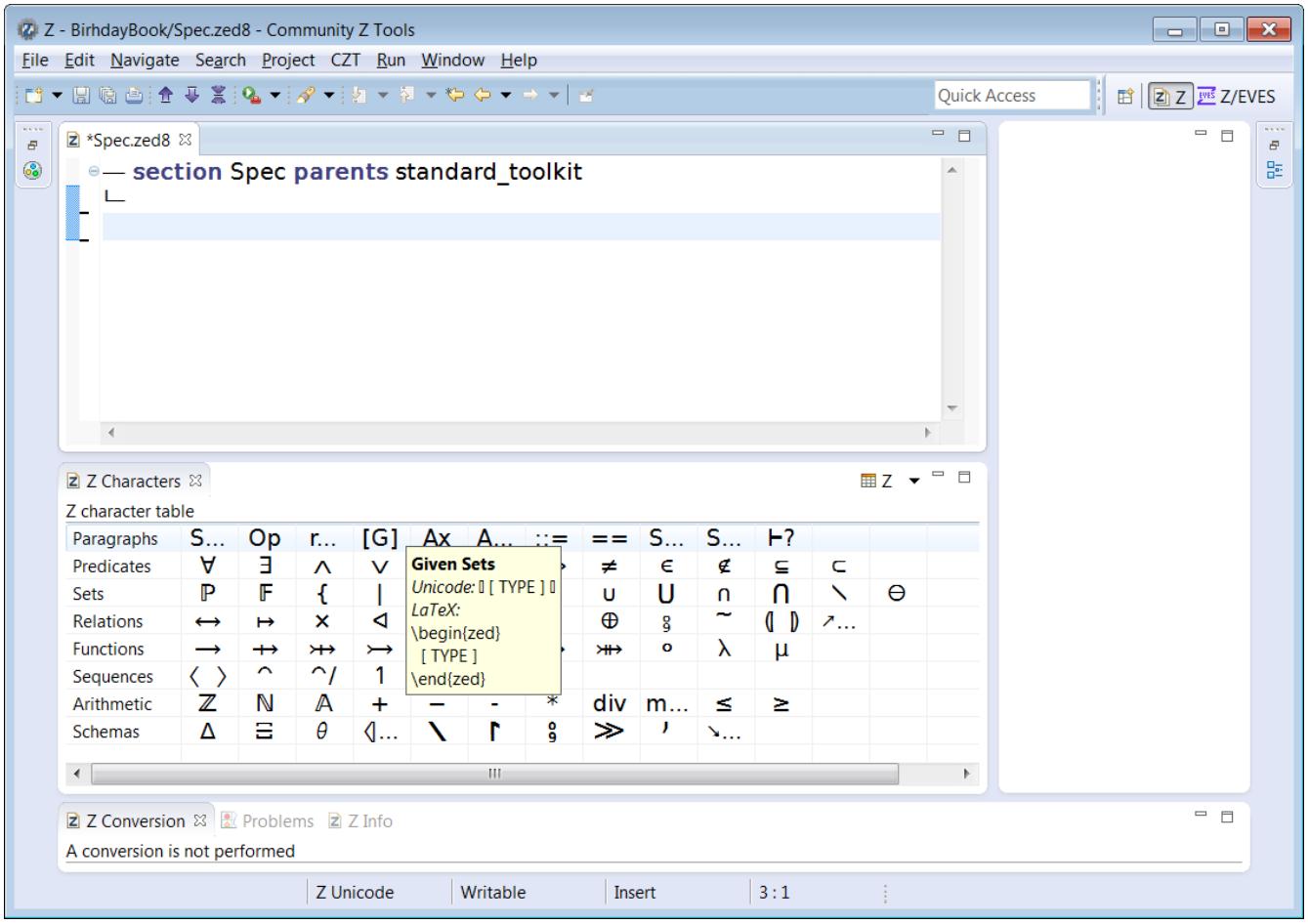
- In this wizard, enter the name of the new Z specification (please use Lab_1_<your ID> for the name) and folder (\BirthdayBook).
- As the Z specification can be written using LaTeX or Unicode, you need specify a markup for the new specification. Choose Unicode (UTF 8) markup.

- The name of the new specification will be the name you specified appended by the extension corresponding to the selected markup.





- Then the new specification will be created and opened in the workbench window.

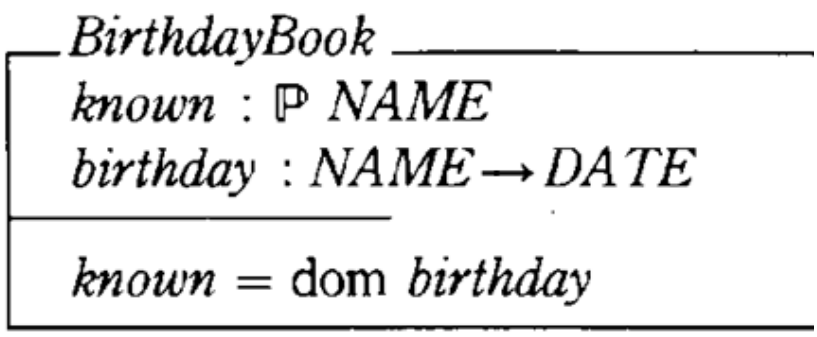


4. Develop Z specification of BirthdayBook for recording people's birthdays.

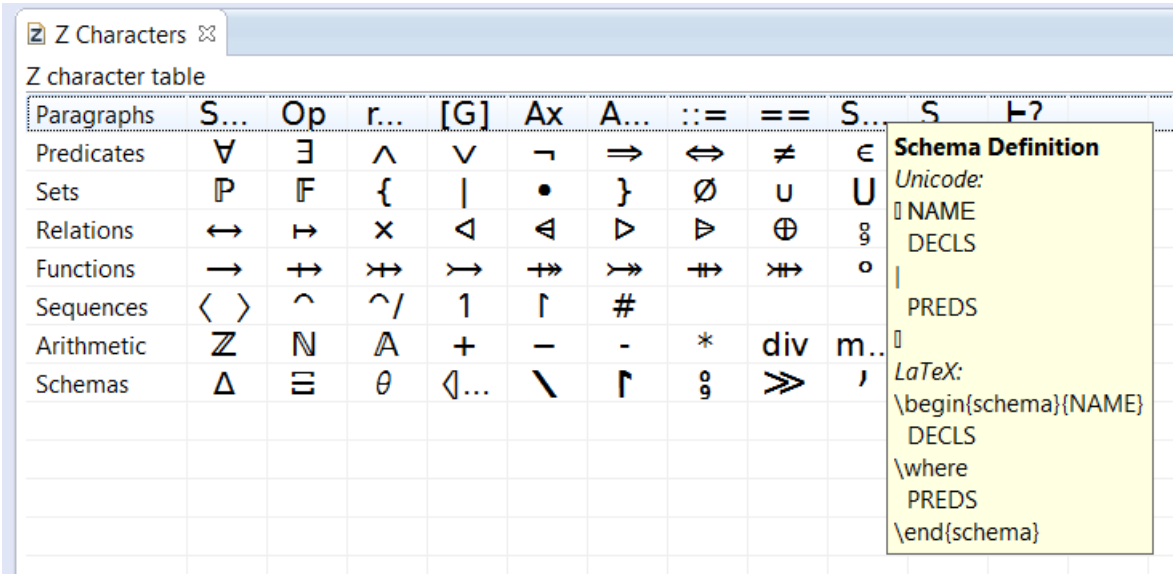
5. First, define [NAME, DATE] as the basic types of the specification.

   For it, find in Z character table the [G] cell (Given Sets) and press it (see the figure above).

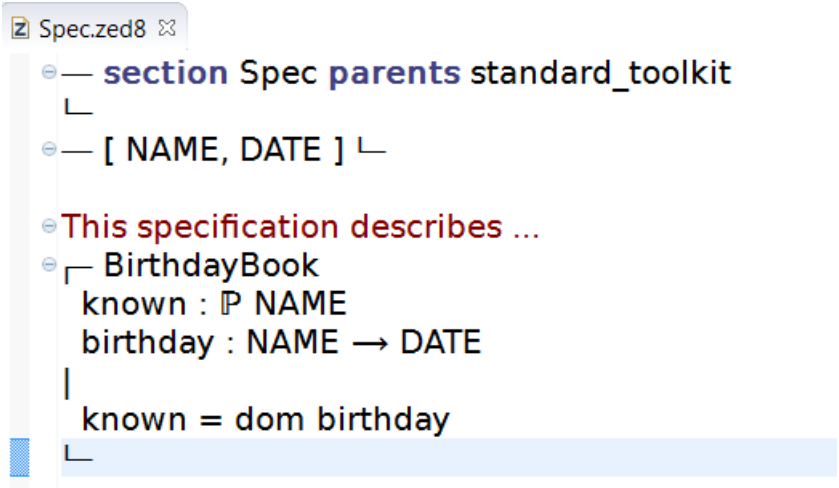
6. Flowing given below description, develop *BirthdayBook* schema.



To do it, find in the Z character table the Sch (Schema Definition) template and insert it into your specification.



As result, at this stage your Z specification should looks like



Please insert showing your understanding comments inside Z specification. Note, CZT-IDE consider as comments any text, placed outside of the schemas (see e.g. "This specification describes ..." in above figure).

7. Specify Dynamic Aspects of the schema by AddBirthday operation.

$$
\begin{array}{|l}
\textit{AddBirthday} \\
\Delta BirthdayBook \\
name? : NAME \\
date? : DATE \\
\hline
name? \notin known \\
birthday' = birthday \cup \{name? \mapsto date?\} \\
\hline
\end{array}
$$

8. Add FindBirthday operation.

$$
\begin{array}{|l}
\textit{FindBirthday} \\
\Xi BirthdayBook \\
name? : NAME \\
date! : DATE \\
\hline
name? \in known \\
date! = birthday(name?) \\
\hline
\end{array}
$$

9. Add *Remind* operation.

$$
\begin{array}{|l}
\textit{Remind} \\
\Xi BirthdayBook \\
today? : DATE \\
cards! : \mathbb{P}\, NAME \\
\hline
cards! = \{ n : known \mid birthday(n) = today? \} \\
\hline
\end{array}
$$

10. Describe the *initial state* of the system.

$$
\begin{array}{|l}
\textit{InitBirthdayBook} \\
BirthdayBook \\
\hline
known = \varnothing \\
\hline
\end{array}
$$

11. Strengthening *AddBirthday*

    Define the type *REPORT* ::= *ok* | *already_known* | *not_known* (use the *freetype* definition symbol)

12. Define *Success* and *AlreadyKnown* schemas

Success

$$result! : REPORT$$

$$result! = ok$$

AlreadyKnown

$$\Xi BirthdayBook$$
$$name? : NAME$$
$$result! : REPORT$$

$$name? \in known$$
$$result! = already\_known$$

13. Combine schemas *Success* and *AlreadyKnown*

$$RAddBirthday \triangleq (AddBirthday \land Success) \lor AlreadyKnown$$

14. Define the schema *NotKnown*

NotKnown

$$\Xi BirthdayBook$$
$$name? : NAME$$
$$result! : REPORT$$

$$name? \notin known$$
$$result! = not\_known$$

15. Combine the schemas

$$RRemind \triangleq Remind \land Success$$

$$RFindBirthday \triangleq (FindBirthday \land Success) \lor NotKnown$$

16. Upload your labsheet with commented properties and explanations into Kalam. Only file Lab_1_<your ID>.zed8 is needed.

    Please note, your lab is a subject for plagiarism checking. Most important are showing your understanding and *unique* comments inside developed Z specification.