# Appendices

## Sequence generation using TagMaps

In the DICOM objects that contain sequences, the sequence templates defined in TagMaps (Sec. 2.3) are populated using the Algorithm 1.

**Algorithm 1**. *Creation of sequences of arbitrary length from one mapped element.*

**procedure** create sequence(template)

new\_el ← template.first\_element

new\_seq ← empty\_sequence

db\_data ← template.get\_data\_list

#Comment: Fetch sequence data from DB

n\_elements ← db\_data.length

**for** i = 1 : n\_elements **do**

i\_element = new element.deep\_copy()

new\_el ← Controller.evaluate(db\_data[i], i\_element)

#Comment: populate i-th element's with DB data

new\_seq.add(new\_el)

**end** **for**

**return** new\_seq

**end** **procedure**

The corresponding DICOM-RT class contains methods to evaluate each sequence. The sequence generation methods implement following steps:

1. Locate and process the TagMap entry to determine the number of elements to generate;
2. Create an empty sequence element;
3. Populate the empty element with the data from the vendor storage and d) add the element to the sequence.

The steps 2 and 3 are repeated, until all sequence data are processed.

## TagMap production

To create a TagMap for a DICOM-RT type, we first generated an XML representation or “stub” of the desired type using dcm2xml utility from the dcm4che2 DICOM toolkit.8 Then, the contents of each tag in the stub file were replaced by the XPath queries to locate the tag content, such as scan acquisition date, inside a tomotherapy patient archive. Alternatively, an empty stub file can be created from scratch using the vendor’s DICOM Conformance Statement for reference.

### TomoTherapy RTDOSE TagMap

The RT-Dose TagMap fragment (Code Example B1) illustrates four data access methods:

1. **Direct selection** implemented in the tag *Patient’s Name*. The patient’s name is stored in an XML node patient, sub-node briefPatient, and sub-sub-node patientName. This method is applicable when the location XPath is unique.

2. **Conditional selection** is used to select one data element by its features.

It is demonstrated in the private tag *Dose Cube Description*, where the XPath query returns only the volume descriptions with the label “Opt Dose After EOP” (optimized dose after end of planning).

3. **Text substitution** is applied when tag contents do not vary, e.g. the *Manufacturer* tag. The values of these tags were set to the values specified by the tomotherapy DICOM Conformance Statement and are not modified by the corresponding *DicomReader* class.

4. **Fragment evaluation** is shown in the tag *Slice Thickness*, where the hash (’# ’) character indicates that the data mapping will be run only on a selected fragment of the archive. The fragment selection is encoded in the tag Dose Cube Description, which is removed from the exported DICOM object after evaluation.

**Code Example B1**: *A simplified RTDOSE TagMap fragment for tomotherapy v4.xx. Comments are highlighted in green, keywords in blue and* *XML element contents in purple.*

<!--Patients Name-->

<attr tag="00100010">//patient/briefPatient/patientName</attr>

<!--Manufacturer = CONSTANT-->

<attr tag="00080070">TomoTherapy Incorporated</attr>

<!--Dose Cube Description.-->

<attr tag="00990099">//doseVolumeList[imageType=’Opt\_Dose\_After\_EOP’]

</attr>

<!--Slice Thickness-->

<attr tag="00180050">#arrayHeader/elementSize/z\*number(10) </attr>

<!--Referenced Image Sequence-->

<attr tag="00081140">

<item>

<!--Referenced SOP Class UID = CONSTANT-->

<attr tag="00081150">1.2.840.10008.5.1.4.1.1.2</attr>

<!--Referenced SOP Instance UID-->

<attr tag="00081155">//plannedStructureSet/\*/modifiedAssociatedImage</attr>

</item>

</attr>

### Pinnacle RTDOSE

TagMaps can be used to translate any vendor storage into DICOM-RT, provided the storage structure is understood well. Code Example B2 shows an RT-Dose TagMap fragment for Pinnacle© Treatment Planning System v9.8. Pinnacle stores text data as “label=value” pairs optionally grouped into sections. The text and raw data for one patient are stored as files in a single folder. The data assembly from multiple files is implemented using the file attribute associated with each DICOM tag. So, the Slice Thickness tag is populated from the subsection “DoseGrid” of the “Plan.Trial” file, and multiplied by the factor 10 to convert centimetres to millimetres, while the tag PatientID is mapped to the “PatientID” entry in the “Patient” file.

**Code Example B2***: Simplified fragments of RT Dose TagMap for Pinnacle 9.8.*

<dicom>

<!--Specific Character Set = CONSTANT-->

<attr tag="00080005">ISO\_IR 100</attr>

<!--Instance Creation Date-->

<attr tag="00080012" file="Plan.PlanInfo">TimeStamp</attr>

<!--Patient ID-->

<attr tag="00100020" file="Patient">PatientID</attr>

<!--Slice Thickness-->

<attr tag="00180050" file="Plan.Trial">(DoseGrid .VoxelSize .Z)\*10</attr>

<!--Study ID-->

<attr tag="00200010" file="ImageSet\_0.ImageSet">StudyID</attr>

<!--Series Number-->

<attr tag="00200011" file="plan.Trial">SeriesNumber</attr>

</dicom>