CONTENTS

CHAPTER 1

Introduction

1.1. Introduction 1
1.2. Characteristics of the region and the paediatric problem domain 2
1.3. Needs of the region 8
  1.3.1. Levels of benefits 9
  1.3.2. Levels of usage 12
    1.3.2.1. Usage of expert systems 13
    1.3.2.2. Levels of benefits: towards a model 14
  1.3.3. Present system 17
1.4. Aim of the work 20
1.5. Summary of the work 20
References 22

CHAPTER 2

Fetal Growth Performance of the region

2.1. Introduction 25
2.2. Materials and methods 26
2.3. Smoothing of data 27
2.4. Observations 27
  2.4.1. Birth weight 27
  2.4.2. Incidence of low birth weight 27
  2.4.3. Incidence of pre-term delivery 27
2.5. Intra-uterine growth of fetus 28
  2.5.1. A comparison between lower and higher socio-economic mothers of North-Bengal region 28
  2.5.2. Birth weight of lower and higher socio-economic group of North-Bengal region and its comparison with Western studies 29
  2.5.3. Intra-uterine growth pattern of fetus of Indian and Western mothers 31
CHAPTER 3

Growth performance of children of the region

3.1. Introduction 48
3.2. Aims and objectives 48
3.3. Study design 49
3.4. Sample size 49
3.5. The Anthropometric measurements 49
  3.5.1. Weight 49
  3.5.2. Length 49
  3.5.3. Height 49
  3.5.4. Head circumference 50
  3.5.5. Chest circumference 50
  3.5.6. Mid-arm circumference 50
3.6. Smoothing of data 50
3.7. Growth parameters 51
3.8. Growth velocity charts 65
  3.8.1. Boys 65
  3.8.2. Girls 75
3.9. Growth Acceleration / Retardation 85
  3.9.1. Boys 85
  3.9.2. Girls 91
3.10. Results and Discussion 96
References 98
CHAPTER 4

Factors affecting growth performance of children of the region

4.1. Introduction 99
4.2. Materials and methods (Drinking water) 100
4.3. The method of water collection 101
4.4. Data analysis (Water) 102
   4.4.1. Water samples taken during post-monsoon on December'93 102
   4.4.2. Water samples taken during pre-monsoon on May-June'94 103
4.5. Criteria of safe water as per WHO 104
4.6. Incidence of Diarrhoeal diseases (North Bengal Region) 105
4.7. Materials and Methods (Rearing technology) 106
   4.7.1. Rearing technologies 106
   4.7.1.1. Incidence of breast feeding from references 106
   4.7.1.2. Incidence of breast feeding from our present study in North-Bengal region 107
   4.7.1.3. Children’s diet from 12 months to 60 months 109
4.8. Results and Discussion 110
   4.8.1. Water study 110
   4.8.2. Rearing technology 111
References 112

CHAPTER 5

Domain - Expert system relationship

5.1. Introduction 114
5.2. AI and expert systems technology: an introduction 114
   5.2.1. Categories and application areas of expert systems 116
   5.2.2. Application trends 129
   5.2.3. Components of an expert system 132
   5.2.4. Typical features of an expert system 135
   5.2.5. Major stages of expert system development 136
   5.2.6. Types of expert systems 138
      5.2.6.1. Based on reasoning 138
      5.2.6.2. Based on other technological advancement 141
5.3. Why it is an expert system domain 148
5.4. What requirements the domain lays on an expert system 149
5.5. Conclusions and Discussion 152
References 153
CHAPTER 6

Knowledge representation 159

6.1. Introduction 159
6.2. Some knowledge representation (KR) schemes 159
   6.2.1. Logic as knowledge representation in expert system 160
   6.2.2. knowledge representation using semantic nets 161
   6.2.3. knowledge representation using rules 162
   6.2.4. knowledge representation using frame concepts 172
   6.2.5 knowledge representation using scripts 173
   6.2.6 Object-attribute-value triplets as KR scheme 174
   6.2.7 Object-oriented approach 175
       6.2.7.1 Classes 175
       6.2.7.2 Instance objects 175
       6.2.7.3 Attributes and methods / operations 176
       6.2.7.4 Inheritance 176
       6.2.7.5 AI, Expert systems and O-O technology 178
6.3. Analysing relative suitability 180
6.4. Some representative expert systems and ES-development tools 182
6.5. The present problem domain of child growth and development (CGD) 185
6.6. Discussions 187
References 188

CHAPTER 7

Prototype system (version 1.0, version 1.1 and version 1.2) 191

7.1. Introduction 191
7.2. Prototyping and prototyping cycle 192
7.3. Phase refinement vs. prototyping 194
7.4. Stages of expert system evolution 195
7.5. Prototype(version 1.0) 195
    7.5.1. A typical consultation session 197
7.6. Prototype(version 1.1) 198
    7.6.1. Modularity, structuredness and O-O knowledge representation 199
    7.6.2. Uncertainty in information 199
    7.6.3. Static and dynamic knowledge bases 200
    7.6.4. Portability 200
    7.6.5. Modifiability 201
    7.6.6. Implementation 201
    7.6.7. A typical consultation session 202
7.7. Prototype(version 1.2) 204
    7.7.1. General description 204
    7.7.2. Knowledge base 205
    7.7.3. Inference engine 205
    7.7.4. Review management 206
    7.7.5. Analysing process 206
    7.7.6. Consulting the system 207
7.8. Conclusions and discussion 210
References 211
# CHAPTER 8

Inexactness

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.1</td>
<td>Introduction</td>
<td>213</td>
</tr>
<tr>
<td>8.2</td>
<td>Sources and nature of inexact information</td>
<td>213</td>
</tr>
<tr>
<td>8.2.1</td>
<td>Uncertain information</td>
<td>214</td>
</tr>
<tr>
<td>8.2.2</td>
<td>Fuzzy information</td>
<td>214</td>
</tr>
<tr>
<td>8.2.3</td>
<td>Simultaneous occurrence of uncertainty and fuzziness</td>
<td>215</td>
</tr>
<tr>
<td>8.2.4</td>
<td>Uncertain-fuzzy</td>
<td>215</td>
</tr>
<tr>
<td>8.2.5</td>
<td>Non-monotonic nature</td>
<td>215</td>
</tr>
<tr>
<td>8.3</td>
<td>Tools for managing inexact information</td>
<td>217</td>
</tr>
<tr>
<td>8.3.1</td>
<td>Bayesian Probability theory</td>
<td>217</td>
</tr>
<tr>
<td>8.3.2</td>
<td>Dempster / Shafer theory of evidence</td>
<td>218</td>
</tr>
<tr>
<td>8.3.3</td>
<td>Stanford certainty factor model</td>
<td>220</td>
</tr>
<tr>
<td>8.3.4</td>
<td>Fuzzy set theory</td>
<td>222</td>
</tr>
<tr>
<td>8.3.5</td>
<td>Non-monotonic reasoning</td>
<td>222</td>
</tr>
<tr>
<td>8.4</td>
<td>Suitability analysis</td>
<td>223</td>
</tr>
<tr>
<td>8.4.1</td>
<td>Bayesian probability theory</td>
<td>223</td>
</tr>
<tr>
<td>8.4.2</td>
<td>Dempster / Shafer theory of evidence</td>
<td>223</td>
</tr>
<tr>
<td>8.4.3</td>
<td>Stanford certainty factor model</td>
<td>224</td>
</tr>
<tr>
<td>8.4.4</td>
<td>Fuzzy set theory</td>
<td>224</td>
</tr>
<tr>
<td>8.4.5</td>
<td>Non-monotonic reasoning</td>
<td>225</td>
</tr>
<tr>
<td>8.5</td>
<td>Conclusions and Discussion</td>
<td>225</td>
</tr>
</tbody>
</table>

References 226

# CHAPTER 9

Fuzzy Concepts and Paediatrics

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1</td>
<td>Introduction</td>
<td>229</td>
</tr>
<tr>
<td>9.2</td>
<td>Basics of fuzzy logic and fuzzy set theory</td>
<td>230</td>
</tr>
<tr>
<td>9.3</td>
<td>Fuzzy concepts in 'Neonates' problem domain</td>
<td>236</td>
</tr>
<tr>
<td>9.4</td>
<td>Prototype system(version 2.0)</td>
<td>238</td>
</tr>
<tr>
<td>9.4.1</td>
<td>A typical consultation session</td>
<td>239</td>
</tr>
<tr>
<td>9.5</td>
<td>Conclusions</td>
<td>241</td>
</tr>
</tbody>
</table>

References 241
CHAPTER 10

Tool Selection

10.1. Introduction 244
10.2. Background 244
   10.2.1. No general purpose tool 244
   10.2.2. Single or multiple tools 245
   10.2.3. In search of a bird after constructing a cage 246
   10.2.4. Non-standard terminologies 246
   10.2.5. Exaggerated claims from vendors / agents 247
   10.2.6. Miscellaneous issues: price, training and documentation support 247
   10.2.7. Language, shell or toolkit 247
      10.2.7.1. Applicability 247
      10.2.7.2. Abstraction 248
      10.2.7.3. Facilities 248
      10.2.7.4. Costs 248
         10.2.7.4.1. Hardware 248
         10.2.7.4.2. Software 248
         10.2.7.4.3. Training 248
   10.2.8. Left no stone unturned - is it practically feasible? 250
   10.2.9. Potentially active research field 250
   10.2.10. Any unique framework? 251
10.3. ES-building tools’ capabilities 251
   10.3.1. Turbo Prolog 252
   10.3.2. Level5 Object 264
   10.3.3. Requirements vs. capabilities 270
10.4. Conclusions and discussion 272
References 272

CHAPTER 11

A Fuzzy, Knowledge-Based Neonatal Resuscitation Management System 274

11.1. Introduction 274
11.2. System analysis 274
11.3. Fuzzification of system state input variables 276
11.4. Fuzzification of system state output variable 278
11.5. Inferencing process 279
11.6. Performance evaluation 281
11.7. Conclusions 282
References 282
Appendix A

Child activities

Appendix B

List of Publications