MATH 436 Final Exam Solutions (Spring 2008)

1. (a) (5 points) State the Real Spectral Theorem.

    Solution. Let V be a real inner-product space, and $T \in \mathcal{L}(V)$. There exists an orthonormal basis consisting of eigenvectors of T if and only if T is self-adjoint.

   (b) (5 points) Let V be a real inner-product space and let $T \in \mathcal{L}(V)$. Is T diagonalizable if it is a normal operator? Is T diagonalizable if it is an isometry? Explain.

    Solution. The answer to both questions is NO. An isometry is normal, so it is enough to give an example of an isometry which is not diagonalizable. Let $V = \mathbb{R}^2$ and T be the rotation by an angle $0 < \theta < \pi$; in terms of matrices this is

    $$\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}.$$

    Then T is an isometry which has no eigenvectors.

2. (10 points) Suppose V is an inner-product space (real or complex). Let $T \in \mathcal{L}(V)$. Prove that the eigenvalues of T^*T are real non-negative numbers.

    Solution. Let $v \neq 0$ be an eigenvector of T^*T with eigenvalue λ. Then

    $$\lambda(v, v) = (\lambda v, v) = (T^*Tv, v) = (Tv, Tv).$$

    Hence $\lambda = (Tv, Tv)/(v, v)$. Since (v, v) is a real positive number and (Tv, Tv) is a real non-negative number, we conclude that λ is a real non-negative number.

3. (10 points) Let V be the subspace of $\mathbb{R}^4$ spanned by

    $$(3, 2, 0, 0), \qquad (-1, 1, -5, 0), \qquad (5, 3, 1, 0).$$

    Find a basis of V.

    Solution. Note that $(-1, 1, -5, 0) + 5(5, 3, 1, 0) = (24, 16, 0, 0) = 8(3, 2, 0, 0)$, so $\dim(V) \leq 2$. On the other hand, since $(3, 2, 0, 0)$ and $(-1, 1, -5, 0)$ are clearly linearly independent, $\dim(V) \geq 2$. Therefore, $\dim(V) = 2$ and $\{(3, 2, 0, 0), (-1, 1, -5, 0)\}$ form a basis.

4. (10 points) Let A be a complex matrix with characteristic polynomial $x(x+1)(x-1)^3$. Describe the possible Jordan forms of A.

    Solution. The number of Jordan forms is equal to the number of decompositions of 3 into non-increasing sums of positive integers. There are three of those: $3 = 3$, $3 = 2+1$, and $3 = 1+1+1$. The corresponding matrices are

    $$\begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}, \begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}, \begin{pmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}.$$

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Resources in Education ,2000-04   Mathematics 436 - Finely Explained Rob Shutler,2004 This book deals with the geometric aspects of the Quebec mathematics course numbered 436 The history of this course depicts a difficult and confusing path with results measured in failures and frustration The course is meant for students expecting to go on to studies in the technical and scientific fields Unfortunately there has been a dearth of material to explain the course The reality is that it has been a source of confusion for administrators teachers parents and most unfortunately students Rob Shutler has attempted to leave the fighting and finger pointing behind and concentrate on explaining the material The book follows a traditional path and provides painstaking detail to explain each topic and provide a plethora of examples The underlying feature of this book is its secure connection to the provincial exam that provides the final and ultimately deciding evaluation for students The book could be used as a textbook for classroom use or as a stand alone resource for a committed besieged student It is an excellent foundation resource for any mathematics teacher   *Automotive Industries* ,1913 Vols for 1919 include an Annual statistical issue title varies   **Cloze and Coherence** John W. Oller,Jon Jonz,1994 Cloze procedure is a family of testing and teaching methods that leave blanks in discourse and ask examinees to restore the missing elements Edited and coauthored by award winning scholars Cloze and Coherence shows how and why cloze procedure is sensitive to discourse constraints and it offers a comprehensive theory of semiotics showing what coherence is and reviewing a great deal of cloze research It traces in particular the history of cloze research pertaining to studies of coherence from Hermann Ebbinghaus in the 1890s to Wilson L Taylor in the 1950s until today The research presented here aims to show that cloze scores tend to fall if discourse constraints are disrupted Also explored are many subtle questions associated with this tendency Populations discussed include native and nonnative speakers of English native and nonnative speakers of French and certain special populations such as deaf subjects and educable mentally retarded subjects Contrary to some experts it appears from the theory and the research that all of the normal subject populations as well as the special populations examined here benefit from the cognitive momentum gained from the episodic organization of ordinary discourse This finding is sustained by research from Taylor Oller et al Cziko Bachman Jonz and Taira Further some of Jonz s recent work shows why scrambling encyclopedic text Timothy Shanahan and colleagues failed to produce any significant decrement in cloze scores Jonz demonstrated empirically that some texts just as Gary A Cziko had predicted are not made more difficult by scrambling their sentences because the sentences of those texts are in some cases arranged in the manner of a list rather than a logically or chronologically structured series Scrambling the list therefore has no significant impact The final chapter of this study gives a comprehensive review of research reportedly showing that cloze is not sensitive to coherence The authors show that all those efforts suffer from fatal flaws Cloze and Coherence offers advances of two kinds First a better theoretical basis for experimental research on discourse comprehension and on literacy and language acquisition is

presented which stems from a fleshed out semiotic theory Second experimental advances whose results are published here for the first time appear in various studies by Jonz Chihara et al Oller et al and Taira This work is well researched and illustrated It includes figures tables appendices a glossary and an index It will be a valuable tool for language and literacy testers and teachers   **The Automobile** ,1913   The Publisher ,1901   *Resources in Education* ,1995   *English Mechanic and World of Science* ,1907   *The Publishers' Circular* ,1865   **English Mechanic and Mirror of Science** ,1907   **Catalog of Copyright Entries. Third Series** Library of Congress. Copyright Office,1976   **Publishers' Circular and Booksellers' Record of British and Foreign Literature** ,1901   *The Publishers' Circular and General Record of British and Foreign Literature* ,1865   *Publishers' circular and booksellers' record* ,1865   The Publishers' Circular and Booksellers' Record of British and Foreign Literature ,1901   **English Mechanic and Mirror of Science and Art** ,1906   *Current Index to Journals in Education* ,1999   International Books in Print ,1990   Cumulated Index Medicus ,1994   Index Medicus ,2003 Vols for 1963 include as pt 2 of the Jan issue Medical subject headings

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Table of Contents Answers Math 436 Exams Quebec

1. Understanding the eBook Answers Math 436 Exams Quebec
    - The Rise of Digital Reading Answers Math 436 Exams Quebec
    - Advantages of eBooks Over Traditional Books
2. Identifying Answers Math 436 Exams Quebec
    - Exploring Different Genres
    - Considering Fiction vs. Non-Fiction
    - Determining Your Reading Goals
3. Choosing the Right eBook Platform
    - Popular eBook Platforms
    - Features to Look for in an Answers Math 436 Exams Quebec
    - User-Friendly Interface
4. Exploring eBook Recommendations from Answers Math 436 Exams Quebec
    - Personalized Recommendations
    - Answers Math 436 Exams Quebec User Reviews and Ratings
    - Answers Math 436 Exams Quebec and Bestseller Lists

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