主辦單位：應用數學系

協辦單位：國科會數學研究推動中心

東華大學

中華民國九十四年八月二十六～二十七日

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2005 年組合數學研討會議程

8 月 26 日（五） 會場：東華大學理工學院第二講堂

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08:50～09:00	開幕
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09:50～10:05	茶會
Session 2.	主持人：周文賢（中央研究院數學研究所）
10:05～10:30	嚴志弘（國立交通大學應用數學系） *Linear k-arboricity of Complete Multipartite Graphs*
10:30～10:55	張又蘋（國立暨南國際大學資訊工程學系） *Mutually Independent Hamiltonian Paths in (n, k)-Star Graph*
10:55～11:05	茶會
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11:05～11:30	劉維展（國立交通大學應用數學系） *On the Diameter of a Mixed Chordal Ring Network*
11:30～11:55	游靜玟（大同大學應用數學系） *The Study on Topologies of IEH Networks and Directed and Undirected Double-Loop Networks*
11:55～12:20	陳珊妤（大同大學應用數學系） *The Study on the Dense Families and Wide-Diameters of the Triple-Loop Network*
12:20～13:30	午餐
Session 4.	主持人：張薰文（大同大學應用數學系）
13:30～13:55	張惠蘭（國立交通大學應用數學系） *On Nonblocking Three Stage Clos Networks under the Multirate-Multicast Model*
13:55～14:20	郭君逸（國立交通大學應用數學系）

Wide-Sense Nonblocking for 3-stage Clos Network and Multi-$\log_d N$ Network

14:20～14:45　黃怡銘（國立中山大學應用數學系）
The Rearrangeability of Banyan-type Networks

14:45～15:00　茶會

Session 5.　主持人：阮夙姿（國立暨南國際大學資訊工程學系）

15:00～15:25　呂明欣（國立交通大學應用數學系）
Triangle-free distance-regular graphs

15:25～15:50　顏珮嵐（國立中山大學應用數學系）
The Convexity Spectra and the Strong Convexity Spectra of Graphs

15:50～16:00　茶會

Session 6.　主持人：顏經和（真理大學數學系）

16:00～16:25　陳怡靜（國立暨南國際大學資訊工程學系）
The Enhanced Pyramid Network: An Attractive Alternative to the Pyramid Network

16:25～16:50　藍國元（國立交通大學應用數學系）
On Degenerate Double-Loop L-Shapes

16:50～17:15　莊玉麟（國立暨南國際大學資訊工程學系）
A Study on Secret Sharing Scheme

17:15～18:00　晚餐

2005 年組合數學研討會議程

8 月 27 日（六） 會場：東華大學理工學院第二講堂

Session 1. 主持人：朱緒鼎（國立中山大學應用數學系）

09:00～09:50 張鎮華（國立台灣大學數學系）
Vogan diagrams and the classification of real simple Lee algebras

09:50～10:05 茶會

Session 2. 主持人：徐力行（大華技術學院資訊工程系）

10:05～10:30 羅經凱（國立交通大學應用數學系）
Efficient Tag-Based Routing Algorithms for the Backward Network of a Bidirectional General Shuffle-Exchange Network

10:30～10:55 藍珮珊（國立中央大學數學系）
Wide Diameters and Rabin Numbers of Generalized Folded Hypercube Networks

10:55～11:05 茶會

Session 3. 主持人：黃國卿（靜宜大學應用數學系）

11:05～11:30 徐育鋒（東吳大學數學系）
The number of 4-cycles in 2-factorizations of $K_{n,n}$

11:30～11:55 林遠隆（淡江大學數學系）
The Study of decompositions of $K_{2m,2n}$ *into 4-cycles, 6-cycles, 8-cycles, or 10-cycles*

11:55～12:20 柯富昌（東吳大學數學系）
The number of repeated blocks in indecomposable twofold extended triple systems

12:20～13:30 午餐

Session 4. 主持人：陳伯亮（國立台中技術學院企管科）

13:30～13:55 楊朝祺（國立中山大學應用數學系）
Perfectness of the complements of circular complete graphs

13:55～14:20 吳佼佼（國立中山大學應用數學系）
Graph marking game and colouring game

14:20～14:45	朱安強（國立台灣大學數學系） *Distance Two Labelings on Graphs*
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15:00～15:25	蔡幸儒（國立東華大學應用數學系） *L(2,1)-labeling and list-L(2,1)-labeling of corona of graphs*
15:25～15:50	田昌鑫（國立嘉義大學資訊工程學系） *A Short Note On Minimum Size Of Graphs With Given Bandwidth*
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16:00～16:25	江俊瑩（國立中央大學數學系） *On Steiner centers of graphs*
16:25～16:50	李佳衛（國立暨南國際大學資訊工程學系） *On-line node ranking algorithm of graphs*
16:50～17:15	張飛黃（國立交通大學應用數學系） *The Bounded-shape Sum-partition and the Single-shape Mean-partition Problems*
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論文摘要索引

題　　目：Linear k-arboricity of Complete Multipartite Graphs

姓　　名：嚴志弘

指導教授：傅恆霖

學校系所：交通大學應用數學系

A *decomposition* of a graph is a list of subgraphs such that each edge appears in exactly one subgraph in the list. There are many interesting results and problems in this area. In this thesis, we study a special case of graph decomposition, called the *linear k-arboricity problem*.

A *linear k-forest* is a graph whose components are paths with lengths at most k. The minimum number of linear k-forests needed to decompose a graph G is the *linear k-arboricity* of G, denoted $l_{ak}(G)$. The notion of linear k-arboricity is a natural generalization of *edge coloring* and also a refinement of the concept of *linear arboricity* in which the paths have no length constraints.

In 1982, Habib and Peroche made the following conjecture:

Conjecture. If G is a graph with maximum degree $\Delta(G)$ and $k \geq 2$, then

$$l_{ak}(G) \leq \begin{cases} \left\lceil \dfrac{\Delta(G) \bullet |V(G)|}{2\left\lfloor \dfrac{k \bullet |V(G)|}{k+1} \right\rfloor} \right\rceil & \text{if } \Delta(G) = |V(G)| - 1 \text{ and} \\ \left\lceil \dfrac{\Delta(G) \bullet |V(G)| + 1}{2\left\lfloor \dfrac{k \bullet |V(G)|}{k+1} \right\rfloor} \right\rceil & \text{if } \Delta(G) < |V(G)| - 1. \end{cases}$$

So far, in the literature, quite a few results on the verification of this conjecture have been obtained. For example, when G is a cubic graph, tree, complete graph, or balanced complete bipartite graph, and k is small or $k \geq \left\lceil \dfrac{|V(G)|}{2} \right\rceil - 1$.

In this thesis, we determine the linear 3-arboricity of balanced complete bipartite graphs, complete graphs, and parts of balanced complete multipartite graphs. We also give some substantial results about the linear 2-arboricity of complete bipartite graphs, complete graphs, and balanced complete multipartite graphs. The results obtained are coherent with the corresponding cases of the conjecture mentioned above.

題　　目：Mutually Independent Hamiltonian Paths in (n, k)-Star Graph

姓　　名：張又蘋
指導教授：阮夙姿
學校系所：暨南大學資訊工程學系

Follows [5], $G = (V, E)$ is a graph if V is finite set and E is a subset of $\{(u, v) \mid (u, v)$ is an unorder pair of $V\}$. We say that V is the node set and E is the edge set. For a node u, $N(u)$ denote the neighborhood of u which is the set $\{v \mid (u, v) \in E\}$. For any node of V, denote the degree of u by $\deg_G(u) = |N(u)|$. Two nodes u and v are adjacent if $(u, v) \in E$. A path is represented by $\langle v_1, v_2, \ldots, v_k \rangle$ where $v_i \neq v_j$ for $i, j \in \{1, 2, \ldots, k\}$ and $i \neq j$ and $(v_i, v_{i+1}) \in E$. Denote by $Q(i)$ the i-th node v_i of path $Q = \langle v_1, v_2, \ldots, v_k \rangle$. We also write the path $\langle v_1, v_2, \ldots, v_k \rangle$ as $\langle v_1, Q_1, v_i, v_{i+1}, \ldots, v_j, Q_2, v_t, \ldots, v_k \rangle$, where Q_1 is the path $\langle v_1, v_2, \ldots, v_i \rangle$ and Q_2 is the path $\langle v_j, v_{j+1}, \ldots, v_t \rangle$. We use $d(u, v)$ to denote the distance between u and v.

A path P is a Hamiltonian path if $V(P) = V(G)$. we say two paths $P_1 = \langle v_1, v_2, \ldots, v_k \rangle$ and $P_2 = \langle u_1, u_2, \ldots, u_k \rangle$ are independent if $P_1(i) = P_2(i)$ for $i \in \{1, k\}$, and $P_1(i) \neq P_2(i)$ for $1 < i < k$. We say a set of Hamiltonian paths $\{P_1, P_2, \cdots, P_s\}$ of G are mutually independent if any two different paths in the set are independent.

An interconnection network connects the processors of the parallel computer. Its architecture can be represented as a graph in which the nodes correspond to processors and the edges to connections. Hence we use graphs and networks interchangeably. There are many conflicting requirements in designing the topology for computer networks. The n-cube is one of the most popular topologies [6]. The star network S_n was proposed in [1] as "an attractive alternative to the n-cube" topology for interconnecting processors in parallel computers.

[5], C.K. Lin , H.M. Huang, S. Bau, and L.H. Hsu prove that there exist $(n - 2)$ mutually independent hamiltonian paths in S_n between any two distinct nodes from different bipartite sets if $n \geq 4$. And they say the result is optimal. Since the topology of $S_{n,k}$ is like S_n, we want to prove that there exist $(n - 2)$ mutually independent hamiltonian paths in $S_{n,k}$ between any two distinct nodes if $n > k \geq 1$ and $n \geq 5$.

Key word: Hamiltonian Path, Independent, Independent Hamiltonian Paths, Mutually Independent, Mutually Independent Hamiltonian Paths, Star Graphs S_n, (n, k)-Star Graphs $S_{n,k}$, Hamiltonian cycle, Independent Hamiltonian cycles, Mutually Independent Hamiltonian cycles

題　　目：On the Diameter of a Mixed Chordal Ring Network
姓　　名：劉維展
指導教授：陳秋媛
學校系所：交通大學應用數學系

Recently, Chen, Hwang and Liu [3] proposed a new network called the mixed chordal ring network which is very comparable to the double-loop network. They proved the surprising result that the mixed chordal ring network can achieve diameter about $\sqrt{2N}$ which is a huge improvement over the double-loop network (here N is the number of nodes in the network). They derived the upper and the lower bounds for the diameter of a mixed chordal ring network. The purpose of this thesis is to propose an $O(\log N)$-time algorithm for deriving the exact value of the diameter of a mixed chordal ring network.

Keywords: Chordal ring network, double-loop network, diameter, connectivity.

題　　目：The Study on Topologies of IEH Networks and Directed and Undirected Double-Loop Networks

姓　　名：游靜玟

指導教授：張薰文

學校系所：大同大學應用數學系

Recently, various networks are proposed for transmitting mass information. Based on the studies of network topologies, we can evaluate the performance of a network. Concerning the properties of the number of nodes and edges, the diameter, optimal routing, disjoint paths, fault-tolerant routing, etc., the topology of a network can provide the complexity of hardware, transmission delay, optimal data communication, fault-tolerant approach, and system performance. In this thesis, we will study the topologies of the incrementally extensible hypercube (IEH) network and the directed and undirected double-loop (DDL and UDL) networks.

The IEH network was proposed in 1992 to be a variety of the hypercube. Without restriction of the number of nodes, the IEH network preserves many advantages of the hypercube and has been widely studied. However, some properties of the IEH network are incorrect and have been misused. In this thesis, we first simplify the construction of an IEH network and correct the mistakes in previous papers. Then we present an optimal routing and a fault-tolerant routing of the IEH network.

The wide-diameter of a network provide a measure of fault-tolerance and suggest optimal data communication. On the other hand, the isomorphism and embedding between networks can provide the substitution of networks. In the second part of this thesis, we study the topologies of the DDL and UDL networks. We present internally node-disjoint paths in both networks and determine the wide-diameter. Moreover, we find the isomorphisms and embeddings among DDL networks, UDL networks, meshes, tori, and ILLIAC networks.

題　　目：The Study on the Dense Families and Wide-Diameters of the Triple-Loop Network

姓　　名：陳珊妤
指導教授：張薰文
學校系所：大同大學應用數學系

With simple construction and node-symmetric properties, multiple-loop networks have been widely studied and used in data communication. Relative to low reliability and long transmission delay of single-loop (ring) networks and to high hardware complexity of high-loop networks, in this thesis, we concentrate on the triple-loop network.

In the triple-loop network $TL(N;s_1,s_2,s_3)$, every node connects to the nodes with differences s_1 , s_2 , and s_3 . There are two important dual problems of dense families. One is to find the maximum number of nodes for fixed diameters, which has an important application to maximizing the support of services under fixed transmission delay. The other one is to find the minimum diameter for a fixed number of nodes by determining three parameters, which has an application to finding minimum transmission delay. Note that the problem of dense families is difficult because it is not monotonic. In the first part of this thesis, we survey the literatures and present five dense families of triple-loop networks to improve the previous results.

On the other hand, the wide-diameter of a network is an important measure of fault-tolerance. In the second part of this thesis, we present disjoint paths between any two nodes of the hyper-L triple-loop network and determine the wide-diameter of the hyper-L triple-loop network to be $D+1$, except two cases with $D+2$. Moreover, we apply the disjoint paths to optimal one-to-one data communication of the hyper-L triple-loop network. According to the lengths of disjoint paths, we partition suitable workloads to each path such that the total transmission delay is minimized.

題　　目：On Nonblocking Three Stage Clos Networks under the Multirate-Multicast Model

姓　　名：張惠蘭
指導教授：黃光明
學校系所：交通大學應用數學系

The purpose of this thesis is to survey the scattered piece-meal results on the multirate-multicast model for nonblocking three-stage Clos networks, to fill some gaps and to extend some results. We also do some numerical com-parisons among existing results. It is hoped that our survey will facilitate future researchers to identify open problems and to make further inroads into this very important model with applications to communication and computer networks.

題　　目：Wide-Sense Nonblocking for 3-stage Clos Network and Multi-$\log_d N$ Network

姓　　名：郭君逸
指導教授：黃光明
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The 3-stage network was first proposed by Clos and is one of the most basic multistage interconnecting network. Clos (1953) showed that the number of middle crossbar required for strictly nonblocking is $2n-1$, where n is the number of inlets of an input crossbar. beneš(1965) constructed an example to show that using packing routing strategy can make the number of middle crossbar required lower. This has remained the only example of wide-sense non-blocking 3-stage Clos network which is not strictly nonblocking.

In this thesis, we showed that the number of middle crossbar required for wide-sense nonblocking under several routing strategies: save the unused, packing, minimum index, cyclic static, and cyclic dynamic, which has been studied in the literature is the same as required for strictly nonblocking and extended them to asymmetric 3-stage Clos network. In particular, we prove the same conclusion for the multi-logd N network and extend to a general class of network.

題　　目：The Rearrangeability of Banyan-type Networks

姓　　名：黃怡銘
指導教授：董立大
學校系所：中山大學應用數學所

In the thesis, we study the rearrangeability of the Banyan-type network with crosstalk constraint. Let x, p and c be nonnegative integers with $0 \le x$, $c \le n$ and $n, p \ge 1$. $B_n(x, p, c)$ is the Banyan-type network with, 2^{n+1} inputs, 2^{n+1} outputs, x extra-stages, and each connection containing at most c crosstalk switch elements. We give the necessary and sufficient conditions for rearrangeable Banyan-type networks . $B_n(x, p, c)$. We show that

(a) $B_n(0, p, 0)$ is rearrangeable nonblocking if and only if $p \ge 2^{\left\lceil \frac{n+1}{2} \right\rceil}$.

(b) $B_n(0, p, c)$ is rearrangeable nonblocking if and only if $p \ge 2^{\left\lfloor \frac{n+1}{2} \right\rfloor}$ for $1 \le c \le n+1$.

(c) $B_n(x, p, n+x+1)$ is rearrangeable nonblocking if and only if $p \ge 2^{\left\lfloor \frac{n-x+1}{2} \right\rfloor}$.

(d) $B_n(x, p, 0)$ is rearrangeable nonblocking if and only if $p \ge 2^{\left\lceil \frac{n-x+1}{2} \right\rceil}$.

(e) $B_n(x, p, c)$ is rearrangeable nonblocking if and only if

$$p \ge \begin{cases} 2^{\left\lfloor \frac{n-x+1}{2} \right\rfloor} & \text{if } 1 \le x \le n, \\ 2 & \text{if } x = n, \end{cases}$$

for $1 \le c \le n+x$.

題　　目：Triangle-free disrtance-regular graphs

姓　　名：呂明欣

指導教授：翁志文

學校系所：交通大學應用數學系

Let $\Gamma=(X,R)$ denote a distance-regular graph with distance function ∂ and diameter $d\geq 3$. For $2\leq i\leq d$, by a parallelogram of length i, we mean a 4-tuple $xyzu$ of vertices in X such that $\partial(x,y)=\partial(y,z)=1$, $\partial(x,u)=i$, and $\partial(x,z)=\partial(y,z)=\partial(y,u)=i-1$. Suppose the intersection number $a_1=0$, $a_2\neq 0$ in Γ. We prove the following (i)-(ii) are equivalent. (i) Γ is Q-polynomial and contains no parallelograms of length 3; (ii) Γ has classical parameters. By applying the above result we show that if Γ has classical parameters and the intersection numbers $a_1=0$, $a_2\neq 0$, then for each pair of vertices $v,w\in X$ at distance $\partial(v,w)=2$, there exists a strongly regular subgraph Ω of Γ containing v,w. Furthermore, for each vertex $x\in\Omega$, the subgraph induced on $\Omega_2(x)$ is an a_2-regular connected graph with diameter at most 3.

題　　目：The Convexity Spectra and the Strong Convexity Spectra of Graphs

姓　　名：顏珮嵐
指導教授：董立大
學校系所：中山大學應用數學系

Given a connected oriented graph D, we say that a set $S \subseteq V(D)$ is convex in D if, for every pair of vertices $x, y \in S$, the vertex set of every $x-y$ geodesic ($x-y$ shortest dipath) and $y-x$ geodesic in D is contained in S. The convexity number $con(D)$ of a nontrivial connected oriented graph D is the maximum cardinality of a proper convex set of D. Let $S_C(K_n)$ = {con(D) | D is an orientation of Kn} and $S_{SC}(K_n)$ = {con(D) | D is a strong orientation of Kn}. We show that $S_{SC}(K_3)$ = {1, 2} and $S_C(K_n)$ = {1, 3, 4, ..., n − 1} if $n \geq 4$. We also have that $S_{SC}(K_3)$= {1} and $S_{SC}(K_n)$ = {1, 3, 4, ..., n − 2} if $n \geq 4$. We also show that every triple n, m, k of integers with $n \geq 5$, $3 \leq k \leq n-2$, and $n+1 \leq m \leq \binom{n}{2}$, there exists a strong connected oriented graph D of order n with $|E(D)| = m$ and $con(D) = k$.

題　　目：The Enhanced Pyramid Network: An Attractive Alternative to the Pyramid Network

姓　　名：陳怡靜
指導教授：杜迪榕
學校系所：暨南大學資訊工程學系

The pyramid network (*PM*, for short) has long been proposed for parallel computing, computer vision, and image processing. The *PM* is a hierarchy structure base on meshes. In 2004, we proposed a new hierarchy structure, called the enhanced pyramid network (*EPM*, for short), by replacing each mesh (at layer greater than one) in *PM* with a torus. Clearly, the *EPM* is a supergraph of the *PM* with the same node set.

In this thesis, we first investigate some topological properties of the *EPM*. Secondly, we derive a simple algorithm to construct a path between any two distinct nodes in the *EPM*, and prove that it is a shortest-path routing algorithm. We also proposed an optimal broadcasting algorithm on the *EPM* with respect to message complexity and transmission delay. And then we calculate the average distance of the *EPM*. Finally, we show that the *EPM* is 2-Hamiltonicity. This result is optimal because both the node connectivity and edge connectivity of the *EPM* are four and at most two faults are tolernable. These results show that the *EPM* has better topological properties than the *PM* such as larger node and edge connectivities, smaller average distance, and better fault-tolerant capability. Thus, the *EPM* is an attractive alternative to the pyramid network.

Keywords: Enhanced pyramid networks, pyramid networks, fault-tolerant embedding, routing algorithms, broadcasting algorithms, interconnection networks

題　　目：On Degenerate Double-Loop L-Shapes

姓　　名：藍國元
指導教授：陳秋媛
學校系所：交通大學應用數學系

Most of the results about the L-shapes of double-loop networks are given in terms of the four parameters l, h, p, n. But these parameters are not well defined in the degenerate case. Recently, Cheng and Hwang gave an efficient algorithm to compute the four parameters l, h, p, n of an L-shape which works for both the regular and the degenerate cases. On the other hand, Chen and Hwang gave a set of rules to determine the four parameters of a degenerate L-shape. Unfortunately, the solutions given by the above two methods do not always coincide. In this thesis, we try to understand their respective meanings and their relations.

Keywords: Double-loop network, L-shape, degenerate.

題　　目：Mutually Independent Hamiltonian Paths in (n, k)-Star Graph

姓　　名：莊玉麟
指導教授：阮夙姿
學校系所：暨南大學資訊工程學系

With the development of network, the secret sharing schemes are more important. How do we make the efficiency to be optimal and how to reduce the computing time. Secret sharing scheme is very useful in the application of networks and our life. Up to now, the related papers are still published frequently.

In this thesis, we modified three schemes from previous papers. First, Wu et al.'s proposed a geometric approach for sharing secrets. We proposed a new scheme by using hyperelliptic equation. It is more selection to hide the secrets and the information rate is better. Second, Feldman proposed a verifiable secret sharing scheme. All participant gets their shares can verify their shares true or not. The computing time of our schemes are more efficient than Feldman's scheme. Finally, Yang et al.'s proposed a (t, n) multi-secret sharing based on Shamir's secret sharing. The dealer need not redistribute fresh secret shares to every participant for next secret sharing session. We proposed two new schemes such that the storages are smaller and the computing time are fast than Chien et al.'s scheme..

Keyword: secret sharing scheme, online secret sharing scheme, information rate, geometric approach.

題　　目：Efficient Tag-Based Routing Algorithms for the Backward Network of a Bidirectional General Shuffle-Exchange Network

姓　　名：羅經凱
指導教授：陳秋媛
學校系所：交通大學應用數學系

In [7], Padmanbhan proposed the general shuffle-exchange network (GSEN) and an efficient tag-based routing algorithm for it. In [1], Chen, Liu and Qiu further enhanced the GSEN with bidirectional links. The bidirectional GSEN can be divided into two dependent networks, the forward network and the backward network. Since the forward network is a GSEN, Padmanbhan's tag-based routing algorithm can be applied on it. As for the backward network, Chen et al. [1] proposed a routing algorithm which is based on the idea of inversely using the forward control tag. In this thesis, we will show that the backward network has a wonderful property: for each destination i, there are two backward control tags associated with it such that every source j can get to i by using one of the two control tags. We will use this property to derive efficient algorithms for one-to-one routing and for constructing a routing table.

Keywords: Interconnection network, multistage network, shuffle-exchange network, Omega network, tag-based routing algorithm.

題　　目：Wide Diameters and Rabin Numbers of Generalized Folded Hypercube Networks

姓　　名：藍珮珊
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Reliability, efficiency, security, and broadcasting are important criteria in the design of interconnection networks. Recently, the w-wide diameter $d_w(G)$, the $(w-1)$-fault diameter $D_w(G)$, and the w-Rabin number $r_w(G)$ have been used to determine reliability and efficiency of interconnection networks. In this thesis, we study $d(G)$,$d_k(G)$,$D_k(G)$, $r_k(G)$, and $r_k^*(G)$ of generalized folded hypercube networks having connectivity k.

題　　目：The number of 4-cycles in 2-factorizations of $K_{n,n}$

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A 2-factor of the complete bipartite graph $K_{n,n}$ is a 2-regular spanning subgraph of $K_{n,n}$. A 2-factorization of $K_{n,n}$ is a partition of the edge set of $K_{n,n}$ into 2-factors. Let Q(n) be the set of all x such that there exists a 2-factorization of K_n, containing exactly x 4-cycles. And we define

$$FC(n)=\begin{cases}\{0,1,2,\cdots,\frac{n^2}{4}-2,\frac{n^2}{4}\} & \text{if n is even}\\ \{0,1,2,\cdots,\frac{(n-1)(n-3)}{4}\} & \text{if n is odd}\end{cases}.$$

In this talk, we will discuss the identity Q(n) = FC(n).

題　　目：The Study of decompositions of $K_{2m,2n}$ into 4-cycles, 6-cycles, 8-cycles, or 10-cycles

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A graph is called a bipartite graph if the vertex set of the graph can be partitioned into two disjoint nonempty sets, and any two vertices in the same set are not adjacency. Moreover, if any two vertices in the different set are adjacency, then this bipartite graph is called a complete bipartite graph, and denoted by $K_{m,n}$.

A complete bipartite graph $K_{m,n}$ can be decomposed into some subgraphs if $K_{m,n}$ can be partitioned into edge-disjoint subgraphs, such that the union of vertex sets of these subgraphs is the vertex set of $K_{m,n}$, and the union of edge sets is the edge set of $K_{m,n}$.

In this thesis, we show that when $3 \le m \le 11, 3 \le n \le 9$, if $4p+6q+8r+10s = 4mn$, for all non-negative integers p, q, r, s, then $K_{2m,2n}$ can be decomposed into p 4-cycle, q 6-cycle, r 8-cycle, and s 10-cycle.By using above results, we obtain the following result. For all $m,n \ge 3$ and non-negative integers p, q, r, s, if $4p+6q+8r+10s = 4mn$, then $K_{2m,2n}$ can be decomposed into p 4-cycle, q 6-cycle, r 8-cycle, and s 10-cycle.

題　　目：The number of repeated blocks in indecomposable twofold extended triple systems

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A twofold extended triple system of order v with two idempotent element (TETS(v,2)) is a pair (V,B) where V is a v-set and B is a collection of unordered triple, called block, of type {x,y,z}, {x,x,y} or {x,x,x} such that each pair (not necessarily distinct) belongs to exactly triple and there is only two triple of the type {x,x,x}. It is trivial to see that a TETS(v,2) exists if and only if $v \equiv 1,2 \pmod 3$.

If a TETS(v,2) contains two b_1 and b_2 that are identical as subsets of V, then it is said to be a repeated block. We are interested in the question. Given $v \equiv 1,2 \pmod 3$ and a nonnegative integer k, does there exist an indecomposable TEST(v,2) (that is, cannot have its blocks partitioned into two ETS(v,1)) with exactly k repeated blocks? In this talk, we will give the complete solution for this problem.

題　　目：Perfectness of the complements of circular complete graphs

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For $p \geq 2q$, let $K_{p/q}$ be the graph with vertices 0, 1, 2, . . . , $p - 1$ in which $i \sim j$ if $q \leq |i - j| \leq p - q$. The circular chromatic number $\chi_c(G)$ of a graph G is the minimum of those p/q for which G admits a homomorphism to $K_{p/q}$. The circular clique number $\omega_c(G)$ of G is the maximum of those p/q for which $K_{p/q}$ admits a homomorphism to G. A graph G is circular perfect if for every induced subgraph H of G we have $\chi_c(H) = \omega_c(H)$. In this paper, we characterize those rational numbers p/q for which $\overline{K_{p/q}}$ are circular perfect. We also prove that if $G(n, S)$ is a circulant graph whose generating set S has cardinality at most 3, then $G(n, S)$ is circular perfect.

題　　目：Graph marking game and colouring game

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This thesis discusses graph marking game and graph colouring game.

Suppose $G=(V,E)$ is a graph. A *marking game* on G is played by two players, Alice and Bob, with Alice playing first. At the start of the game all vertices are unmarked. A play by either player consists of marking an unmarked vertex. The game ends when all vertices are marked. For each vertex v of G, write $t(v)=j$ if v is marked at the j th step. Let $s(v)$ denote the number of neighbours u of v for which $t(u)<t(v)$, i.e., u is marked before v. The *score* of the game is

$$s=1+\max_{v\in V} s(v).$$

Alice's goal is to minimize the score, while Bob's goal is to maximize it. The *game colouring number* $\mathrm{col}_g(G)$ of G is the least s such that Alice has a strategy that results in a score at most s.

Suppose $r\geq 1$, $d\geq 0$ are integers. In an $(r,d)-$relaxed colouring game of G, two players, Alice and Bob, take turns colouring the vertices of . with colours from a set X of r colours, with Alice having the ¯rst move. A colour i is legal for an uncoloured vertex x (at a certain step) if after colouring x with colour i, the subgraph induced by vertices of colour i has maximum degree at most d. Each player can only colour an uncoloured vertex with a legal colour. Alice's goal is to have all the vertices coloured, and Bob's goal is the opposite: to have an uncoloured vertex without legal colour. The d-relaxed game chromatic number of a graph G, denoted by $\chi_g^{(d)}(G)$ is the least number r so that when playing the (r,d)-relaxed colouring game on G, Alice has a winning strategy. If $d=0$, then the parameter is called the *game chromatic number* of G and is also denoted by $\chi_g(G)$.

This thesis obtains upper and lower bounds for the game colouring number and relaxed game chromatic number of various classes of graphs. Let $\mathrm{col}_g(\mathcal{PT}_k)$ and $\mathrm{col}_g(\mathcal{P})$ denote the maximum game colouring number of partial k trees and the maximum game colouring number of planar graphs, respectively. In this thesis, we prove that $\mathrm{col}_g(\mathcal{PT}_k)=3k+2$ and $\mathrm{col}_g(\mathcal{P})>11$. We also prove that the game

colouring number $\mathrm{col}_g(G)$ of a graph is a monotone parameter, i.e., if H is a subgraph of G, then $\mathrm{col}_g(H) \le \mathrm{col}_g(G)$. For relaxed game chromatic number of graphs, this thesis proves that if G is an outerplanar graph, then $\chi_g^{(d)}(G) \le 7-t$ for $t = 2,3,4,$ for $d \ge t$, and $\chi_g^{(d)}(G) \le 2$ for $d \ge 6$. In particular, the maximum 4 -relaxed game chromatic number of outerplanar graphs is equal to 3. If G is a tree then $\chi_g^{(d)}(G) \le 2$ for $d \ge 2$.

題　　目：Distance Two Labelings on Graphs

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An $L(2,1)-$labeling of a graph G is a function $f:V(G)\to\mathbb{N}\cup\{0\}$ such that for all $u,v\in V(G)$, we have $|f(u)-f(v)|\geq 2$ if $d(u,v)=1$, and $|f(u)-f(v)|\geq 1$ if $d(u,v)=2$. The $L(2,1)-$labeling number $\lambda(G)$ of G is the smallest number k such that G has an $L(2,1)-$labeling with $\max\{f(v):v\in V(G)\}=k$

In this thesis, we review some proofs for the upper bounds of $\lambda(G)$, and give an alternative proof for $\lambda(G)\leq\Delta^2+\Delta-2$.

題　　目：L(2,1)-labeling and list-L(2,1)-labeling number of corona of two graphs

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Given a graph G with n vertices and a function $L:V(G)\to 2^{\mathbb{N}}$, we say that L is (2,1)-choosable for G if there exists a function $c:\Im=\{L(v_i)|1\le i\le n\}\to A$, $c(L(v_i))=a_i$ for all i, $1\le i\le n$, which satisfies the conditions

(1) $a_i\in L(v_i)$,

(2) $|a_i-a_j|\ge 2$ if $d_G(v_i,v_j)=1$,

(3) $|a_i-a_j|\ge 1$ if $d_G(v_i,v_j)=2$.

In this case, the function c is said to be a (2,1)-choosable function of G with respect to L. If for all the function L with $|L(v_i)|\ge k$ for all $v_i\in V(G)$, there is a (2,1)-choosable function of G with respect to L, then we say that G has a k-list-L(2,1)-labeling. The list-L(2,1)-labeling number of G, denoted by $\lambda_l(G)$, is defined by $\lambda_l(G)=\min\{k|G \text{ has a } k-\text{list-L(2,1)-labeling}\}$. The purpose of this thesis is to study L(2,1)-labeling and list-L(2,1)-labeling number of graphs.

Keywords. L(2,1)-labeling, list-L(2,1)-labeling, corona, complete graphs, path cycle.

題　　目：A Short Note On Minimum Size Of Graphs With Given Bandwidth

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Graph bandwidth problem is a well known NP-Complete problem. The relation between size of a graph and bandwidth is very interesting. This paper provides the minimum size of a graph of order n (n is odd and $n \geq 9$) without isolated vertex and bandwidth $B(G) = \frac{n+1}{2}$ and shows that $K_{2,2n-1}$ is an extremal graph of $m(n, \frac{n+1}{2})$.

題　　目：On Steiner centers of graphs

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Oellermann and Tian presented an algorithm for finding the n-center of a tree in 1990 [3], but the correction of the algorithm seems not sound. In this paper we give a clear proof of the validity of their algorithm.

They also showed a containment relationship for a tree T, $C_n(T)\ \mu\ C_{n+1}(T)$ for $n\ ,\ 2$. We present some graphs G for which $C_n(G)\ 6\mu\ C_{n+1}(G)$. Oellermann asked the following question: Can the n-center and $(n\ ;\ 1)$-center be disjoint? Though the problem is not solved yet, we present an in¯nite family of graphs G such that $C_2(G)$ and $C_4(G)$ are disjoint. Finally, we give an algorithm for ¯nding the n-center of a block graph.

題　　目：On-line node ranking algorithm of graphs

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Given a graph, finding an optimal node ranking is an interesting computational problem. A node ranking of a graph $G=(V,E)$ is a proper node coloring $C:V\to\mathbb{N}$ such that any path in G with end nodes x,y fulfilling $C(x)=C(y)$ contains an internal node z with $C(z)>C(x)$. In the on-line version of the node ranking problem, the nodes $v_1,v_2,\ldots,v_n$ are coming one by one in an arbitrary order; and only the edges of the induced subgraph $G[v_1,v_2,\ldots,v_i]$ are known when the color for the node v_i be chosen. The assigned color cannot be changed later.

In this thesis, we are interesting in on-line node ranking problem. We design one on-line algorithm to find an on-line node ranking for general paths, and its time complexity is $O(n\log n)$. Furthermore, we prove the on-line node ranking algorithm for paths also can be used to find an on-line node ranking for cycles. And we design another on-line algorithm to find an on-line node ranking for general trees with $O(n^3)$ time. We also design an optimal on-line algorithm for special trees, $k_{1,n}$, also called stars. Secondly, we modify our on-line node ranking algorithms to parallel algorithms. Our parallel algorithm needs $O(n\log\log n)$ time using $O(\log n/\log\log n)$ processors to find an on-line node ranking for paths and cycles, and its cost is $O(n\log n)$. And for trees, our algorithm needs $O(n\log^2 n)$ time with using $O(n^3/\log^2 n)$ processors, and its cost is $O(n^4)$

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Keywords: node ranking, on-line, algorithm, path, cycle, tree, star, parallel algorithm.

題　　目：The Bounded-shape Sum-partition and the Single-shape Mean-partition Problems

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The optimal partition problem considers the partition of n objects into p nonempty parts, and finding a partition(optimal partition) to maximize the objective function $F: R^p \to R$. A brute force method is to compare the values of objective function $F(\pi)$ for each partition π. Thus, we are concerned with the number of all partitions which determines whether the brute force method is practical. However, a more desirable solution is to prove that the objective function has some suitable property which leads to the existence of an optimal partition in a special class of partitions. Then, we need pay attention only to this class of partitions.

The vector of the size of each part is called a shape. If a partition problem has a restriction where the size of each part lies in an interval, then it is called a bounded-shape partition problem. If each interval is degenerated, then it is called single-shape partition problem. In Chapter 2, we use the generating function to count the number of ordered(unordered) shapes and the number of bounded-shape partitions. In Chapter 3, we prove that for bounded-shape sum-partition problem with Schur-convex objective function, there must be a nonmajorized shape such that the corresponding size-consecutive partition is optimal. We also bound the number of nonmajorized shapes, and develop an algorithm to find all nonmajorized shape-types. In Chapter 4, we prove that for single-shape mean-partition problem with quasi-convex objective function, there must be a consecutive optimal partition. We also give some new results for the mean-partition problems.

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