# INTERNATIONAL CONFERENCE ON SINGULARITY THEORY
# ECNU，2017

The international conference on singularity theory will be held in Room 504, Block A, Science Building at East China Normal University Zhongbei Campus from July 10 to July 14, 2017.

The purpose is to disseminate current research development in singularity theory and related fields to graduate students, postdoctoral fellows, and mathematicians who are interested in these topics. The topics are related to singularity theory such as Motivic integration, Poincare series, Resolution of singularities, Topology of singularities, Singularities in positive characteristic，singularities in algebraic geometry and etc. We hope to bring students and experts together in an inspiring environment, which facilitates the beginning and the continuing of research collaborations and dissemination.

Participants are encouraged to engage in informal discussions between and after the lectures.

## Organizing Committee

Rong Du
East China Normal University,China
rdu@math.ecnu.edu.cn

Yun Gao
Shanghai Jiaotong University, China
gaoyunmath@sjtu.edu.cn

Laurentiu Maxim
University of Wisconsin-Madison,USA

## Secretary

Hongyan Zhang, East China Normal University hyzhang@math.ecnu.edu.cn

## Supported by

Rong Du's NSF of China and Department of Mathematics, East China Normal University

# INTERNATIONAL CONFERENCE ON SINGULARITY THEORY
# ECNU，2017

**Room 504, Science Building A, Zhongbei Campus of ECNU, 3663 Zhongshan North Road, Shanghai.**

**July 10-14, 2017**

# Timetable

| Time | July 10 | July 11 | July 12 | July 13 | July 14 |
|---|---|---|---|---|---|
| 8:50—8:55 | Welcome Speech of Dean Tan | | | | |
| 9:00—9:50 | Ein | Brosnan | Yokura | Oka | Jiang |
| 9:50—10:10 | Coffee Break | Coffee Break | Coffee Break | Coffee Break | Coffee Break |
| 10:10—11:00 | Budur | Schürmann | Ohmoto | Okuma | Pflaum |
| 11:10—12:00 | Wang | Seade | Takeuchi | Burghelea | Melle Hernández |
| LUNCH | LUNCH | LUNCH | LUNCH | LUNCH | LUNCH |
| 14:00—14:50 | Zuo | Li | | Fullwood | Luengo |
| 14:50—15:10 | Coffee Break | Coffee Break | | Coffee Break | Coffee Break |
| 15:10—16:00 | Liu | Cogolludo Agustín | | González Villa | Fernandez De Bobadilla |
| 18:00— | | Banquet | | | |

# INTERNATIONAL CONFERENCE ON SINGULARITY THEORY
# ECNU，2017

**Room 504, Science Building A, Zhongbei Campus of ECNU, 3663 Zhongshan North Road, Shanghai.**

**July 10-14, 2017**

# Titles and Abstracts

## Hessenberg varieties, monodromy and the Shareshian-Wachs conjecture

**Patrick Brosnan**
University of Maryland, USA

**Abstract:** *I will explain joint work with Tim Chow which proves a conjecture of Shareshian and Wachs relating a combinatorial object, the chromatic quasi-symmetric function, to an action of the symmetric group on the cohomology of certain smooth subvarieties of a flag manifold, the regular semi-simple Hessenberg varieities. The proof reinterprets the symmetric group action, originally defined by Tymoczko in terms of equivariant cohomology, as a monodromy action. We then show that this action can be computed in terms of the cohomology of certain degenerations of the Hessenberg varieties which, although singular, happen to have palindromic cohomology groups (i.e., groups that numerically satisfy Poincare duality). There is an interesting independent proof of the conjecture by Guay-Paquet and I will mention this as well.*

## Absolute sets and the Decomposition Theorem

**Nero Budur**

KU Leuven, Belgium

**Abstract:** *The celebrated Monodromy Theorem states that the eigenvalues of the monodromy of a polynomial are roots of unity. In this talk we give on overview of recent results on local systems achieving a vast generalization of the Monodromy Theorem. We end up with a conjecture of André-Oort type for special loci of local systems. The conjecture is true in rank one, and if true in general, it would provide a simple proof in all generality of the DecompositionTheorem of Beilinson-Bernstein-Deligne-Gabber. Joint work with Botong Wang.*

## Towards a computational MORSE-NOVIKOV theory

**Dan Burghelea**

Ohio State University, USA

**Abstract:** *In this talk I will sketch a computer friendly alternative to Morse-Novikov theory and explain what it can do for the topology of complements of complex hypersurfaces in $C^n$, in particular about the calculations of basic topological invariants of such varieties.*

## Quasi-projective Artin groups and the QP K(π,1)-conjecture

**Jos éIgnacio Cogolludo Agust ń**

University of Zaragoza, Spain

**Abstract:** *A group is called quasi-projective if it can be realized as the fundamental group of a quasi-projective space. Even quasi-projective Artin groups are fully characterized in terms of their graph in a joint work with R.Blasco. We will discuss recent results on a potential characterization of quasi-projective groups as well as the QP K(π,1)-conjecture, that is, whether or not such groups can be realized by Eilenberg-MacLane quasi- projective spaces.*

# Properties of vector bundles on the resolutions of surface singularities

**Lawrence Ein**

University of Illinois at Chicago, US

**Abstract:** *Line bundles on a resolution of a surface singularities has been studied extensively. We study some of the properties of vector bundles on such a resolution. We give applications to the study of the Hilbert schemes of zero dimensional schemes on a singular surfaces.*

# A canonical Chern class for embeddable schemes

**James Fullwood**

University of Hong Kong

**Abstract:** *For a scheme which is embeddable in a smooth variety (over an arbitrary algebraically closed field), we define a canonical characteristic class in its group of algebraic cycles modulo rational equivalence, which coincides with its total homological Chern class when the scheme is smooth. The definition is very similar to the definition of Fulton's canonical class, but with a modification according to the singularities of the scheme. If the underlying field is algebraically closed of characteristic zero and the scheme is embeddable as a hypersurface in a smooth variety, then it immediately follows via a formula of Aluffi that the class we define coincides with its Chern-Schwartz-MacPherson class, and we conjecture that this is in fact true even when the scheme is not a hypersurface in a smooth variety. If true, the definition of the class we define would yield a very simple formula for the Chern-Schwartz-MacPherson class of arbitrary embeddable schemes, and since our class is defined for fields of arbitrary charcteristic, the class we define may lead to a functorial theory of singular Chern classes in positive characteristic.*

## Multiplier ideals associated to plane curve singularities

**Manuel González Villa**

University of Wisconsin-Madison, USA

**Abstract:** *Multiplier ideals and their jumping numbers are a powerful tool to study the singularities of an ideal on complex algebraic variety with mild singularities. Jumping numbers of (analytically) irreducible plane curve singularities have been independently computed and studied by Jarvilehto, Naie and Tucker. We will report in a work in progress to describe the multiplier ideals associated to irreducible plane curve singularities. This is a joint work with Carlos Rodrigo Guzman (CIMAT).*

## Representation of surface homeomorphisms by tête-à-tête graphs

**Javier Fernandez de Bobadilla**

Basque Center for Applied Mathematics, Spain

**Abstract:** *We use tête-à-tête graphs as defined by N. A'Campo and extended versions to codify all periodic mapping classes of an orientable surface with non-empty boundary, improving work of N. A'Campo and C. Graf. We also introduce the notion of mixed tête-à-tête graphs to model some pseudo-periodic homeomorphisms. In particular we are able to codify the monodromy of any irreducible plane curve singularity. The work ends with an appendix that studies all the possible combinatorial structures that make a given filtered metric ribbon graph with some regularity conditions into a mixed tête-à-tête graph.*

## Falk Invariants of signed Graphic arrangements

**Guangfeng Jiang**

Beijing University of Chemical Technology, China

**Abstract:** *The fundamental group of the complement of a hyperplane arrangement in a complex vector space is an important topological invariant. The third rank of successive quotients in the lower central series of the fundamental group was called Falk invariant of the arrangement since M. Falk gave the first*

*combinatorial formula and asked to give a combinatorial interpretation. We proved that the Falk invariant of an arrangement associated with signed graph G without loops is double of the sum of $k_3$, $k_4$ and $k_3^{\pm}$, where $k_l$ is the number of subgraphs of G that are switching equivalent to the cliques with l vertices, $k_3^{\pm}$ is that of subgraphs which have 3 vertices and each two vertices are connected by double edges with different signs. This formula modifies the one given by H. Schenck and A. Suciu, and answers partially Falk's question in the case of signed graphic arrangements.*

## Enumerating curves with prescribed singularities, and beyond

**Jun Li**

Stanford Univeristy, USA

**Abstract:** *I will report the approach to enumerating nodal curves via cobordism theory, initiated by Tzeng; on the later joint work with Tzeng on enumerating curves with arbitrary prescribed singularities. Some later development will also be discussed.*

## Topology of smooth closed subvarieties of complex semi-abelian varieties

**Yongqiang Liu**

KU Leuven, Belgium

**Abstract:** *We use the non-proper Morse theory of Palais-Smale to investigate the topology of smooth closed subvarieties of complex semi-abelian varieties, and that of their infinite cyclic covers. As main applications, we obtain the finite generation (except in the middle degree) of the corresponding integral Alexander modules, as well as the signed Euler characteristic property and generic vanishing for rank-one local systems on such subvarieties. Furthermore, we give a more conceptual (topological) interpretation of the signed Euler characteristic property in terms of vanishing of Novikov homology. As a byproduct, we prove a generic vanishing result for the L^2 Betti numbers of very affine manifolds. Our method also reproves and generalizes a theorem of*

*June Huh about the master function on very affine manifolds to smooth closed sub-varieties of semi-abelian varieties. This is a joint work with Laurentiu Maxim and Botong Wang.*

## Bernstein polynomial of 2-Puiseux pairs irreducible plane curve singularities

**Ignacio Luengo**

Universidad Complutense de Madrid, Spain

**Abstract:** *I will report on a joint work with E. Artal, P. Cassou-Nogues and A. Melle (arxiv 1611.01091 ). In 1982, Yano proposed a conjecture predicting the b-exponents of an irreducible plane curve singularity which is generic in its equisingularity class. In a previous work we proved the conjecture for the case in which the germ has two Puiseux pairs and its algebraic monodromy has distinct eigenvalues. In this work we aim to study the Bernstein polynomial for any function with the hypotheses above. In particular the set of all common roots of those Bernstein polynomials is given.*

## Power structure over the Grothendieck ring of maps

**Alejandro Melle Hernández**

Universidad Complutense de Madrid, Spain

**Abstract:** *A power structure over a ring is a method to give sense to expressions of the form $(1+a_1t+a_2t^2+...)^m$, where $a_i$ (i=1, 2,...) and m are elements of the ring. The (natural) power structure over the Grothendieck ring of complex quasi-projective varieties appeared to be useful for a number of applications. In this talk we meanly focus on the Grothendieck ring of maps of complex quasi-projective varieties. I describe two natural $\lambda$-structures on it which lead to the same power structure. We show that this power structure is effective. In the terms of this power structure we write some equations containing classes of Hilbert-Chow morphisms. We describe some generalizations of this construction for maps of varieties with some additional structures. This is a joint work with S.M. Gusein-Zade and I. Luengo.*

# C1-triangulation and semialgebraic de Rham homotopy theory

**Toru Ohmoto**

Hokkaido University, Japan

**Abstract:** *I will talk about a solution to a fundamental question on the $C^1$-regularity of triangulations for semialgebraic sets (over any real closed field). It would be useful for e.g. the semialgbraic de Rham homotopy theory introduced by Kontsevich-Soibelman. This is a joint work with Masahiro Shiota.*

# Łojasiewicz exponents of non-degenerate holomorohic and mixed functions

**Mutsuo Oka**

Tokyo University of Science, Japan

**Abstract:** *We consider Łojasiewicz inequalities for a non-degenerate holomorphic function with an isolated singularity at the origin. We give an explicit estimation of the Łojasiewicz exponent in a slightly weaker form than the assertion in Fukui. For a weighted homogeneous polynomial, we give a better estimation in the form which is conjectured by S. Brzostowski, T. Krasiński and C. Oleksik under under some condition (the Łojasiewicz non-degeneracy). We also introduce Łojasiewicz inequality for strongly non-degenerate mixed functions and generalize this estimation for mixed functions.*

# Cohomology of ideals in normal surface singularities

**Tomohiro Okuma**

Yamagata University, Japan

**Abstract:** *We study normal surface singularities in terms of cohomology of ideal sheaves on resolution spaces. We introduce an invariant q for integrally closed ideals in the local ring of normal surface singularities. We show that the ideals with maximal q satisfy some nice properties. The invariant q induces the normalized reduction number r of the singularities. Rational singularities are characterized by r=1. We show that (weakly)*

*elliptic singularities satisfy r=2. This is based on joint works with Kei-ichi Watanabe and Ken-ichi Yoshida.*

## Stratified groupoids and inertia spaces

**Markus Pflaum**

University of Colorado-Boulder, USA

**Abstract:** *The inertia space of a compact Lie group action or more generally of a proper Lie groupoid has an interesting singularity structure. Unlike the quotient space of the group action, respectively the groupoid, the inertia space can not be stratified by orbit types, in general. In the talk we explain this phenomenon and provide a stratification and local description of the inertia space. Moreover, we show that that leads naturally to the concept of a stratified groupoid which lies in between the one of a Lie groupoid and the one of a topological groupoid. Finally we show that a de Rham theorem holds for inertia spaces and explain the connection of the inertia space with the non-commutative geometry of the underlying groupoid.*

## On Ginzburg's bivariant Chern classes for singular spaces

**Jörg Schürmann**

University of Münster, Germany

**Abstract:** *We explain an extension of the (equivariant) MacPherson Chern class transformation to a bivariant theory with respect to suitable convolutions as conjectured by Ginzburg. This is based on the Lagrangian approach via characteristic cycles. As an application we show, that for flag manifolds G/B the two cohomological Weyl group actions constructed by Ginzburg and Aluffi-Mihalcea coincide. These Weyl group actions permute the (equivariant) Chern classes of the corresponding Schubert cells. This is joint work with P. Aluffi, L. Mihalcea and C. Su.*

## Milnor classes for complete intersections

**José Seade**

UNAM, Mexico
**Abstract:** *I will speak about my work with R. Callejas-Bedregal and M. Morgado, where we describe the total Milnor class of the intersection of a finite number of hypersurfaces, under certain conditions of transversality, in terms of the Milnor classes of the hypersurfaces.*

## On the monodromies and the limit mixed Hodge structures of families of algebraic varieties

**Kiyoshi Takeuchi**

University of Tsukuba, Japan

**Abstract:** *We study the monodromies and the limit mixed Hodge structures of families of complete intersection varieties over a punctured disk in the complex plane. For this purpose, we express their motivic nearby fibers in terms of the geometric data of some Newton polyhedra. In particular, the limit mixed Hodge numbers and some part of the Jordan normal forms of the monodromies of such a family will be described explicitly. This is a joint work with Takahiro Saito.*

## Algebraic geometry approach to enumerative combinatorics

**Botong Wang**

University of Wisconsin-Madison, USA

**Abstract:** *We will discuss two applications of algebraic geometry in enumerative combinatorics. The first one is the proof of the "top-heavy" conjecture of Dowling and Wilson in 1975 using hard Lefschetz theorem for intersection cohomology groups. The conjecture is a higher dimensional generalization of the following theorem due to de Bruijn and Erdos: n points in the plane determine at least n lines unless all the points lie on a line. The second one is the proof of a log-concave conjecture on the number of independent sets using Hodge index theorem. This is joint work with June Huh.*

## On poset-stratified spaces and related topics

**Shoji Yokura**

Kagoshima University, Japan

**Abstract:** *I will discuss some thoughts about poset-stratified spaces from a naive general topological viewpoint and talk about some applications such as hyperplane arrangements and a poset-stratified space structure of the set of morphisms of a small category.*

## Non-existence of negative weight derivations of isolated singularities and new Lie algebras

**Huaiqing Zuo**

Tsinghua University, China

**Abstract:** *Let $R=C[x_1,x_2,..., x_n]/(f_1,..., f_m)$ be a positively graded Artinian algebra. A long-standing conjecture in algebraic geometry, commutative algebra and rational homotopy theory is the non-existence of negative weight derivations on R. Alexsandrov conjectured that there are no negative weight derivations when R is a complete intersection algebra and Yau conjectured there are no negative weight derivations on R when R is the moduli algebra of a weighted homogeneous hypersurface singularity. This problem is also important in rational homotopy theory and differential geometry. Wahl conjectured that non-existence of negative weight derivations is still true for positive dimensional positively graded R. In this talk we present our recent progress on these problems. Joint work with Stephen Yau, Hao Chen and Bingyi Chen.*

# Campus Map
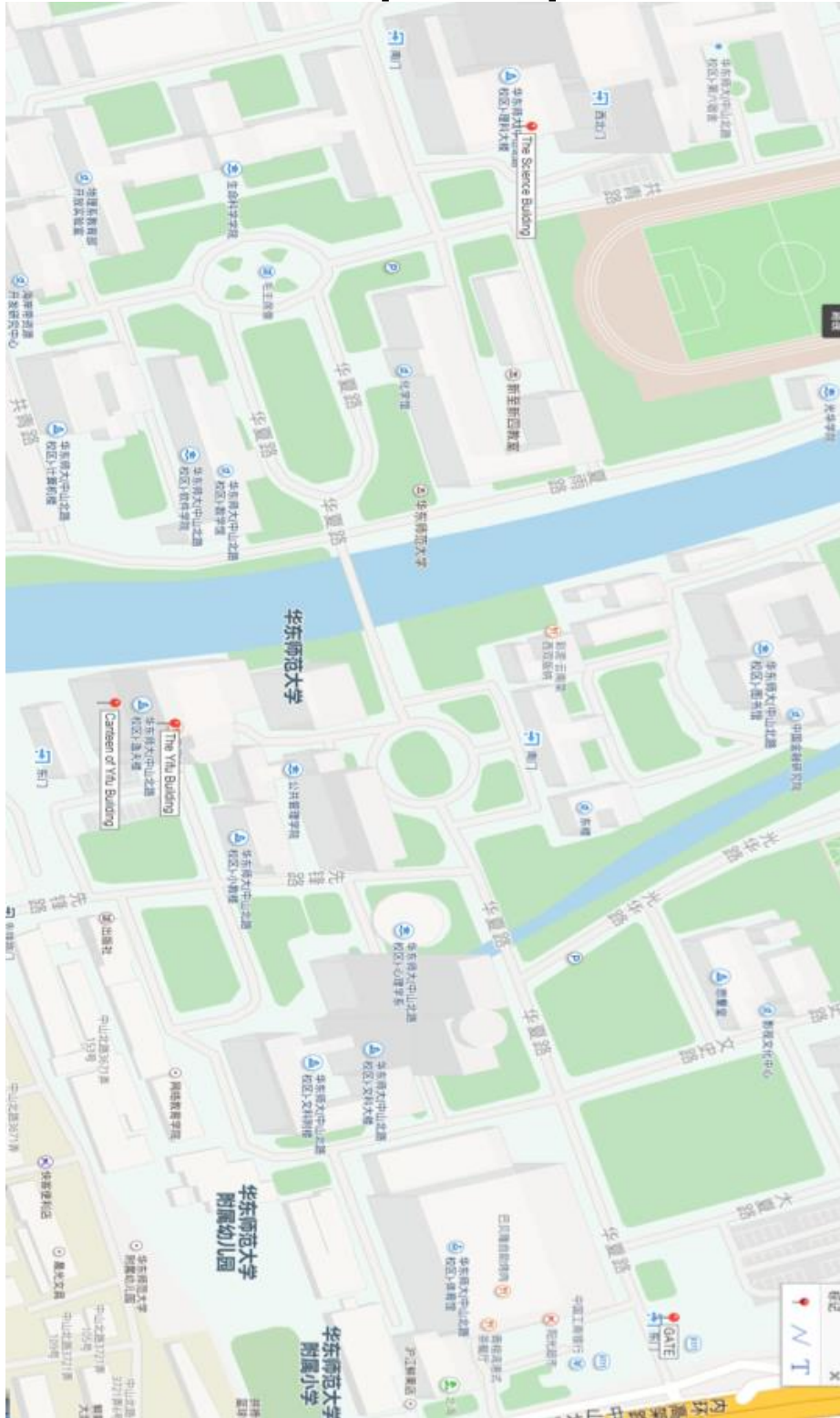
**Hotel:**

Yifu Building
Address: No. 3663, North Zhongshan Road （中山北路）, Putuo, Shanghai.
Tel: 86-21-62601058

**Lunch:**

Buffet in the canteen of the first floor of Yifu Building except Tuesday. On Tuesday, lunch will be provided in the canteen of the second floor of Yifu Building.

**Dinner:**

We will provide boxed meal if you need except Tuesday. At 6:00 pm on Tuesday, there is a banquet in the canteen of the first floor of Yifu Building and your presence is welcome.

**Location of the Conference:**

Room 504, Science Building A.

**Shanghai tips:**

    1. Google services in China are very unreliable. Use Bing services (Bing search, Bing map) instead.

    2. No need to tip in restaurants.

    3. Don't drink water directly from the tap. Local people boil tap water before drinking. Drink bottled water.

    4. Many malls and cafes have free Wi-Fi. However, you will need a local cell phone number to receive the password via a text message. Therefore, don't count on having free Wi-Fi.

    5. Don't speak to strangers if they approach. Those are likely con artists who are trying to scam tourists.

    6. The subway system works well in Shanghai. Avoid rush hours. Download a subway app on your smart phone. Get an octopus card.

**Recommended shopping areas:**

    1. IAPM Mall on Huaihai Middle Road is a good place to go for restaurants and shops.

    2. A place with a little bit of everything is Ganghui Plaza 66, not far from Jiaotong University (downtown campus).

    3. IFC Mall in Lujiazui, Pudong is also great.

    4. Xin Tian Di is a good place for upscale restaurants and bars (there is even a Bavarian restaurant there).

    5.The food courts in big malls(usually located in the basement) are always fun to visit.

**Online shopping:**

    Online shopping is certainly the best way to shop in China. Retail stores carrying western brands are ridiculously expensive. Taobao.com and JD.com are two of the most popular online shopping venues for Chinese. Shipping is almost free and delivery is super fast, especially JD.com. For non-Chinese speakers, check out baopal.com.

**Walking:**

1. Nanjing East Road's eastern, pedestrian-only part is nice but it is a tourist trap (beware the scammers). Nanjing West Road, between Jin An Temple and Westgate Mall, is more walkable.
2. Another popular tourist attraction is Waitan (the waterfront), or the Bund. Best way to reach it is to walk east on the pedestrian-only Nanjing Road till the end.
3. Not far from JW Marriott at Tomorrow Square is People's Square. There is the Shanghai Museum (free), Shanghai Urban Planning Exhibition Hall (also free). They are worth a visit. Then you can walk through Raffles Mall and move onto Nanjing East Road; go east all the way to Waitan
4. Huaihai Middle Road between IAPM Mall and Madang Road is very walkable. Go south on Madang Road and you'll reach Xin Tian Di.
5. Yu Garden is spectacular, but you need to get there early in the morning to be able to get in.

**Restaurants/Bars:**

1. For simple-minded western-style food, try Wagas(for pasta) or Element Fresh (for salad).
2. To taste traditional Shanghai soup dumplings, go to Ding Tai Fung. They have a location at IAPM Mall, 3F.
3. For dim sum, go to Daoxiang, also at IAPM Mall 3F.
4. Yang's Dumplings is a cheap and very popular chain serving traditional Shanghai dumplings with crispy bottom Anne juicy filling.
5. The JW Marriott Shanghai at Tomorrow Square. Grab a drink at the 38th floor Lobby Lounge or at the 40th floor JW's Lounge. Excellent views.
6. Barbarossa is a very popular, beautiful bar in a park next to the JW Marriott Shanghai at Tomorrow Square.
7. The Park Hyatt lobby café on 79F of Shanghai World Financial Center(the building with a square hole at the top) at Lujiazui, Pudong offers excellent view at reasonable prices.

8. For Thai food in a park setting, go to Thai Gallery within Jin An Park, across from Jin An Temple. The restaurant looks fantastic at night.
9. Hyatt On The Bund's VUE Bar (on top floor) offers spectacular views of the waterfront and skyline. Closest subway station is Tiantong Road of lines 10 or 12 (plus some walking).

**Smartshanghai.com** is a useful website for researching entertainment options. The website is geared towards expats. For every venue covered, they have a convenient "taxi printout" function, with the address info in both Chinese and English.

**Supermarkets:**
1. For sundries, go to Watson's.
2. Best convenience store chains are FamilyMart and Lawson.