The total amount of different elementary particles in our daily experienced universe.

First of all the amount of different elementary "matter"-particles, i.e. fermions. It is a well known experimental fact that fermions appear in 3 so-called families in our universe, so this can be assumed a known fact. On theoretical grounds it can mathematically be explained why fermions can have more so-called "***families***". One only has to re-write the so-called S(tandard)M(odel) of S(pecial) R(elativistic) Q(uantum)F(ield)T(heories) in compliance with Albert Einstein his C(omprehensive) A(ction) P(rinciple), i.e. to include curvature of spacetime in the simple , because linear, mathematical description.

The **CAP** compliant analysis also implies that of all elementary "force-particles", i.e. **bosons**, just one type of all possible symmetry-groups can be analyzed on mathematical grounds. This explains why (*elementary*) **bosons** never have more so-called "families", for all possible analyzable symmetry-groups. This is why I rather speak of "elementary fermion-families" and ***NOT*** of particle-families.

This is why we only observe one type of massless spin1 **photon** and one type of massless spin2 **graviton**. Where it should be noted that massless elementary particles of-course ***NEVER*** allow more different families, because the only difference between particle-families is the rest-mass and zero remains zero after multiplication with a positive integer and a **CAP** induced constant. But the elementary weak-nuclear force also has just one observed species, while the Z and $W^{\pm}$ gauge-bosons have non-zero rest-masses because some of the members of this symmetry-group are charged.

In the SM, the weak-nuclear forces are described by the SU(2)-gauge symmetry-group. And this conclusion is correct, because it is compliant with the CAP.

And as long as the mathematical description complies to the CAP it can't be proven incorrect on ***simple mathematical*** grounds!

The CAP implies nothing more than including curvature in the mathematical description! And describing curvature mathematically implies a doubling of degrees of freedom. For example an electron described according to the SM is described as a simple point-particle moving along its linear, that is 1D-, worldline. And the doubling of the degrees of freedom to describe curvature now comes to live in two ways! The first cause of curvature is the easily implemented mathematical fact that the worldline itself is curved, i.e. not linear, but has a non-infinite radius of curvature in the 2D-plane orthogonal to the described direction of motion, i.e. the SR-worldline. And the second cause is an harmonic oscillation in the 2D-plane orthogonal to the described direction of motion. This explains why the energy of any possible elementary particle always is proportional to a detectable frequency of this particle.

When solving the D(ifferential) E(quations) of the necessary harmonic oscillation to comply to the CAP, one needs B(oundary) C(onditions) to solve these DE completely! The BC are either open or closed.

Open-BC have an additional degree of freedom in the form of a positive integer. This mathematical open character implies that these particles also always interact in these two directions, so i.e. interact in all spacelike directions. As a result of this simple fact such particles are always massive.
It is now obvious that open-BC describe fermions and the positive integer specifies the Fermi-family.

The higher this number, the more enforced interaction with the spin2 gravitational-field, so the higher the rest-mass.

Closed-BC appear to describe force-particles, i.e. bosons. Of these particles there only exists one species for every degree of freedom of a valid symmetry-group. When all particles represented by this symmetry-group are without electrical charge, these particles will be massless, i.e. without rest-mass. This is why only the spin2 graviton and the spin1 photon are without rest-masses. But these elementary particles as a result this characteristic always move with the speed of light with respect to any observer. Only at the moment of absorption or emission both the graviton and the photon must be described extended in the 2D-plane orthogonal to the direction of absorption or emission.

The EM-field is represented by the spin1 photon and is easily described as an U(1)-gauge-symmetry. In the SM the complete gauge-symmetry is:

$$U(1) \times SU(2) \times SU(3) \qquad (1)$$

The U(1) x SU(2) gauge-symmetry describe mixed by the Weinberg-angle θ_W the photon γ and the neutral Z of the weak-nuclear forces, besides the charged SU(2) gauge-bosons $W^{\pm}$.

The SU(3) gauge-symmetry describes all possible quarks and their interactions. This is usually described in QCD. However, in QCD some characteristics of quarks are not understood.

One of the most troublesome problems in QCD is that one has not got an explanation for the characteristic that quarks cannot be observed on their own, but always appear in combinations of at least 2 quarks.

However, this problem is easily overcome using a complete top-down analysis.

The first problem in this analysis is the amount of required spacial dimensions. The most attractive choice is of-course yielding a 4D-spacetime as used in SR. Because this space is completely imaginable and a s a result of that the most realistic in ones mind.

This problem was solved in 2004 by Grigori Perelman. Together with Richard Hamilton he did research on Ricci Flow with the aim of attacking Henri Poincaré's conjecture of 1904. While Grigori Perelman proved this conjecture he also showed that mathematical knots are only possible in 3D-space, i.e. Einstein's 4D-spacetime.

When realizing that always massive fermions have to be described as harmonic oscillating waves in the 2D-plane orthogonal to the observed direction of motion (SR-world line) to describe them in compliance with the CAP, it is at once clear that one may describe a fermion as moving forward-backward and forward again in such a way that the harmonic oscillating path always allows knots in this oscillating path. This implies that fermions can only be described mathematically in the easy imaginably 4D-spacetime of SR.

Without fermions also no force-particles, i.e. bosons, so nothing at all. As a result of this our reality can only be analyzed mathematically in 4D-spacetime.

In 4D-spacetime we have a restriction in possible variables. Time and the only possible 3D-space only appear in so-called 4-vectors. All possible variables can be given as powers of 4-vectors, with the simplest being a scalar which is the inner product of two 4-vectors.

Besides scalars and 4-vectors there are of course also tensors of some degree $d > 1$, for example the Riemann curvature tensor with four 4-indices, i.e. $d = 4$.

With these only analyzable variables we have a restriction in possible symmetries.

All possible infinitesimal variable transformations are given completely with the most arbitrary 4 x 4 = 16 degrees of freedom transformation tensor:

$$T^{\mu\nu} = S^{\mu\nu} + A^{\mu\nu} \quad (2)$$

This transformation tensor can in just one unique way be described as the sum of a symmetrical transformation tensor $S^{\mu\nu}$ and an ant-symmetrical transformation tensor $A^{\mu\nu}$. Remember that other non-discrete transformations are not possible, i.e. (2) describes all possible non-discrete transformations in any analyzed reality.

Both transformation tensors of (2) can be represented with spin representations. But this will only become logical after the property called spin is really understood. It is easily shown that spin is a fundamental characteristic of elementary particles to describe them in compliance with the CAP. From this analysis it is at once obvious that spin s of any elementary particle has the fundamental property:

$$s > 0 \quad (3)$$

After really understanding spin it becomes logical to represent the transformation tensors of (2) with spin-representations.

The symmetrical transformation tensor $S^{\mu\nu}$ has 10 degrees of freedom and is represented by the following spin-representation:

$S^{\mu\nu}$ can be represented mathematically by spin2 x spin½ (4)

Here spin½ represents the particles with non-zero rest-masses, which are the sources of the spin2 gravitational field.
The anti-symmetrical transformation tensor $A^{\mu\nu}$ has 6 degrees of freedom and is represented by the following spin-representation:

$A^{\mu\nu}$ can be represented mathematically by spin1 x spin½ (5)

Here spin½ represents the electrical charged particles with also non-zero rest-masses, which are the sources of the spin1 EM-field.

As a direct result of this analysis the only observable spin-values of detectable particles are:

s only has values of the set: {½, 1, 2} (6)

This implies that the spin of an elementary particle may only be spin2 or less and of-course (3):

$$2 \geq s > 0 \quad (7)$$

The only not analyzed spin value is s = 1½, and according to (2) such particles are not possible as stable elementary particles. This at once implies that quarks are not spin½ elementary particles with additional so-called isospin, but are just spin1½ elementary particles without isospin. This at once explains why quarks cannot be observed as stable elementary particles on their own.

Right now we have enough information to specify all quantum numbers of all possible elementary particles of our everyday experienced reality:

All fermions possess three different families in our universe. The detectable fermions are either elementary or combined. The elementary fermions are called leptons and the combined fermions are called hadrons. The leptons consist out of electrical charged fermions, together with their ant-particles, and the uncharged neutrinos.

So, the leptons have 3 x 3 = 9 different species in our universe.

All hadrons are combined quark combinations. The fermions are called baryons and the bosons are called mesons and gluons. This implies that from this analysis gluons are ***NOT*** elementary particles, but combined particles build out of 2 quarks. Just like mesons.
There are two quarks for each of the 3 particle-families (up- and down-, charm- and strange-, top- and bottom-quark) and these particles are all electrically charged so also possess their anti-particles built from anti-quarks.

As a result of these characteristics there are a total of 3 x 2 x 2 = 12 different quarks.

We now only need to count the number of elementary bosons to be able to count the total number of possible different elementary particles of our universe.

These bosons are already mentioned in the start of this analysis and are the spin2 graviton and the U(1) x SU(2) gauge-bosons, i.e. the spin1 photon of the EM-field and the quite heavy elementary spin1 gauge-bosons of the weak-nuclear force, i.e. the neutral Z and the electrically charged $W^{\pm}$.

This yields a total of 2 + 3 = 5 elementary bosons.

The total amount of different elementary particles of a universe with n fermion families now is:

$$\text{Amount of different elementary particles} = 5 + n \times 7 \qquad (8)$$

<u>This implies for our 3 families universe: 5 + 3 x 7 = 26 different elementary particles.</u>